Marine Aquaria

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MARINE AQUARIA.

MARINE AQUARIA:

THEIR CONSTRUCTION, ARRANGEMENT, AND MANAGEMENT,

WITH FULL INFORMATION AS TO THE BEST ANIMALS AND SEAWEEDS TO BE KEPT, HOW AND WHERE TO OBTAIN THEM, AND HOW TO KEEP THEM IN HEALTH.

BY

REGINALD A. R. BENNETT, B.A.

(Magdalen College, Oxford).

PROFUSELY ILLUSTRATED.

This Work forms the Second Division of "The Aquarium Book."

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PREFACE.

IN every department of study those are probably best qualified to act as teachers who have actually encountered, and more or less successfully overcome, the difficulties surrounding the particular branch of science or art to which they have applied themselves. It is from this point of view that I venture to address the readers of the following pages, in which I have endeavoured to set forth the principles and practical construction of the Marine Aquarium in a scientific, as well as a popular, manner. If those who are learned in the technical phrases of the naturalist's work-room do not find therein so large a space allotted to scientific details as they would desire, I will ask them to remember that the book is principally intended for those who, while seeking rest and recreation by the seaside, are apt to find the time hang rather heavy on their hands, in the hope that it may supply them with a means of employing themselves in a pursuit which is eminently healthy in itself, and may afterwards lead to a desire for a more extensive knowledge, which can be studied in the larger and more scientifically-written manuals.

The nomenclature I have most extensively followed is that of Mr. P. H. Gosse, bringing it more up to date in the case of Sea-Anemones by reference to Pennington's "British

Zoophytes," and occasionally, in the case of fishes, to Yarrell's "British Fishes."

In the space covered by so small a book, comparatively speaking, as this is, it is of course impossible to give accounts of numerous species of the marine animals, fishes, and plants, which inhabit our shores. I have therefore chosen for notice those which are especially representative of their various families, and which have been practically kept in an aquarium by myself or others, and have therefore proved themselves suitable for domestication.

R. A. R. BENNETT.

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Uniform with "MARINE AQUARIA,"

FRESH-WATER AQUARIA:
Their Construction, Arrangement, and Management; with Full Information as to the Live Stock and Water Plants to be Kept, and How to Keep them.

FULLY ILLUSTRATED.

By the REV. G. C. BATEMAN, M.A.

This Work forms the First Division of "The Aquarium Book."

LONDON: L. UPCOTT GILL, 170, STRAND, W.C.

THE MARINE AQUARIUM.

CHAPTER I.

INTRODUCTION.

ALTHOUGH the study of marine zoology has made enormous strides in the last few years, there are still many people who take their annual holiday at the seaside without the least idea that there is a fund of amusement and reflection close to their hands, which can be easily enjoyed both while there, and afterwards in the inland country, or even in the heart of London itself.

In these chapters it is intended to give a clear and concise account of how a marine aquarium may be set up, stocked, and kept in good order, with the least possible expenditure of time, trouble, and patience, and the smallest possible percentage of failures. In fact, if the directions are implicitly followed, the intending aquarium-keeper ought to suffer very few reverses of fortune.

Before commencing to prepare the tank, however, let us consider the past history of the art of aquarium-keeping, in which the principles were discovered which now guide our actions when setting up the tank; for we are much more likely to be

successful if we master the scientific principles involved before we begin.

In the year 1774, a celebrated chemist named Priestley discovered the gas known as oxygen. This gas he afterwards found to be given off by plants under certain circumstances. Ingenhousz soon afterwards found out that the leaves of plants exposed to the light of day gave forth oxygen gas. Ellis, in his "Treatise on Atmospheric Air" (p. 57, *et seq.*), considers that he disproves this hypothesis. At the third meeting of the British Association for the Advancement of Science, held at Cambridge in the year 1833, Professor Daubeny made a communication respecting experiments on this subject, which satisfied him that in the decomposition of carbonic acid and the evolution of oxygen, the influence of the Vegetable would serve as a complete compensation for that of the Animal, Kingdom.

In the year 1837, Mr. Ward made a report to the British Association "On the Growth of Plants in Closed Cases"; and at the end of this report he "directed the attention of the members to the development of animal life upon the same principles." He was "quite certain that a great number of animals would live and thrive under this treatment." In his treatise, published in 1842, he states that "the animal and vegetable respirations might counterbalance each other"; and in a lecture delivered by Dr. H. S. Ward before the Royal Institution, he states that Mr. Ward in 1841 established, in a capacious earthenware vessel, an aquarium for fish, plants, &c.: "In this vessel, which contained twenty gallons of water, he placed gold and silver fish, in company with several aquatic plants. In this miniature lake—the water of which was never changed, but kept in a constantly pure state by the action of associated plants —the animals lived in a healthy condition for many years."

On the 4th of June, 1850, Mr. Robert Warington communicated to the Chemical Society the results of an experiment which had occupied his attention for some months previously. His paper was "On the Adjustment of the Relations between the Animal and Vegetable Kingdoms, by which the Vital Functions of both are permanently maintained," and in the

course of it he demonstrated that, if fishes are placed in a jar with plants of *Vallisneria spiralis* (the Fresh-water Weed), they will live for an indefinite time without the necessity arising for aërating the water.

These experiments were all performed on fresh-water animals and plants; but in the year 1842 appeared a book, by Dr. Johnston, entitled "A History of the British Sponges and Lithophytes," in which, in a footnote, the author makes a remark which shows that he did actually form a marine aquarium on a small scale.

It seems that to Mrs. Thynne belongs the honour of first introducing marine vivaria into London. She brought some madrepores to London, from Torquay, in the autumn of the year 1846, and kept them in two glass bowls, the sea water being aërated by being daily poured backwards and forwards, and being, moreover, periodically renewed by a fresh supply from the coast. "In the spring of 1847, Mrs. Thynne sent for some pieces of rock, shell, &c., to which living seaweeds were attached, and subsequently depended upon the action of these for the purification of the water."

Later on, in the *Annals of Natural History* for October, 1852 (p. 263), the late Mr. P. H. Gosse published his experiments on marine aquaria. He seemed to find in his first experiments that red seaweeds were best for the purpose, such as *Chondrus crispus* (the Carrageen Moss) and *Iridea edulis* (Dulse or Dillosk), which latter he considered the best of all. Later on, however, he considerably modified his opinion, and it is now generally admitted that the green species of seaweed flourish best in captivity.

From the foregoing explanation, the following facts become apparent as to the balance between the Animal and Vegetable Kingdoms: The gills of fishes are constructed to remove from the water the oxygen which is necessary to their existence, and which is dissolved in small quantities by that fluid. Now, it is evident that if the fishes were to continue using up the oxygen, and no more were to be dissolved, in process of time the supply would become exhausted, and the fishes would immediately perish. This is what actually happens if we introduce

fishes into a vessel the water in which has previously been boiled, so as to expel the air, and allowed to become cold without shaking up. In nature, the oxygen is continually supplied by the motion of the waves on the sea, or the ripples caused by the wind on the water of the pond. But besides these methods, the influence of the Vegetable Kingdom is brought into play, and under the action of light (not necessarily direct sunlight) the plants in the ditches and ponds, and the seaweeds in the ocean, are continually taking up the carbonic acid gas formed by the respiration of the fishes (which, being pernicious to animal life, would be another agent in their destruction) to form their leaves, stalks, &c., and in its stead giving forth pure oxygen, which, dissolving in the water around, keeps up the supply needed by the animals. Thus, then, both parties are mutually useful to each other, and the balance of sub-aqueous existence is satisfactorily maintained, as far as respiration is concerned.

In Mr. Warington's experiments, a cause of difficulty to him was the fact that the plants would not continue to thrive for a long time without some of their leaves decaying; and this, rendering the water impure, was detrimental to the life of the animals in his tank. This difficulty was, as usual, overcome by going to the fountain-head, and observing how the difficulty was overcome in the gigantic aquaria existing in nature. He found that pond snails were especially fond of decaying vegetation, and therefore, on introducing a few of these into his tank, the cause of difficulty was at once removed. What he did in his fresh-water tank by the introduction of pond snails we do in our marine tanks by the introduction of marine snails, the habits of which will be described when we come to them in their proper order.

Mr. Gosse's experiments, detailed below, were undertaken contemporaneously with Mr. Warington's, though neither knew what the other was doing. At first he suffered many misfortunes, as his books testify, but eventually his perseverance met with the reward it deserved; and in his "Handbook to the Marine Aquarium," he states that he had at the time of writing a marine aquarium stocked with all sorts of sea

creatures, which had not been disturbed, nor even the water removed, for three years, during which time the water had remained brilliantly clear.

Although I have no doubt that many of my tanks would have remained clear for an immense length of time, having, in fact, kept them for one and a half, or two years, without turning out the water, yet nevertheless, as the confervæ naturally grow on the rocks to an enormous extent during that time, and the stones, &c., at the bottom get dirty from continued use, I prefer to clear out the tank about once yearly, and replace the water by fresh, the stones composing the rockwork being well scrubbed, to remove adhering vegetable growth, &c.

The main principles of the marine aquarium were now arrived at, but many important improvements were yet to come. The principal of these was the manufacture of artificial sea water, to take the place of the natural fluid, which could not then be obtained from the sea in a state of purity without considerable trouble and expense. The idea, therefore, arose in Mr. Gosse's mind that the water of the sea might be imitated successfully by adding to fresh water the salts found in solution in that of the sea.

In the *Annals and Magazine of Natural History* for July, 1854, Mr. Gosse published the results of his experiments in this direction, which were so interesting that I may, perhaps, be pardoned for quoting from his paper:

"The inconvenience, delay, and expense, attendant on the procuring of sea water from the coast, or from the ocean, I had long ago felt to be a great difficulty in the way of a general adoption of the marine aquarium. Even in London it is an awkward and precarious matter; how much more so in inland towns and villages, where it must always prove not only a hindrance but to the many an insuperable objection. The thought had occurred to me that, as the constituents of sea water were known, it might be practicable to manufacture it, since all that seemed necessary was to bring together the salts in the proper proportions, and to add pure water until the solution was of the proper specific gravity.

"I took Schweitzer's analysis, but as I found there was a

slight difference between his and M. Laurent's, I concluded that a very minute accuracy was not indispensable. Schweitzer gives the following analysis of 1000gr. of sea water taken off Brighton:

Water	964·744
Sodium chloride (salt)	27·059
Magnesium chloride	3·666
Potassium chloride	0·765
Magnesium bromide	0·029
Magnesium sulphate	2·295
Sulphate of lime	1·407
Carbonate of lime	0·033
	999·998

"The bromide of magnesium and carbonate of lime I thought I might neglect, both from the minuteness of their quantities, and also because the former was not found at all by M. Laurent in the water of the Mediterranean, and the latter might be found in sufficient abundance in fragments of shell, coral, and calcareous algæ, thrown in to make the bottom of the aquarium, The sulphate of lime I also ventured to eliminate, on account of its extreme insolubility, and because M. Laurent finds it in excessively minute quantity. The component salts were thus reduced to four, as follows:

Common table salt	¾oz.
Epsom salts	½oz.
Chloride of magnesium	200gr.
Chloride of potassium	4gr.

"To these salts, thrown into a jar, a little less than four quarts of water were added, so that the solution was of such a density that a specific gravity bulb 1·026 would just sink in it. The cost of substances was:

Magnesium sulphate	1d.
Magnesium chloride	3d.
Potassium chloride	1¼d.
Salt	nil.

Total, about 5¼d. per gallon. Of course, if a larger quantity were made the cost of materials would be diminished, so that we may set down 5d. per gallon as the maximum cost of sea

water thus made. The trouble is nothing, and no professional skill is requisite.—PHILIP HENRY GOSSE."

Since the above was written several of the large railway companies have made a special and regular business of the delivery of sea water in London at about 2d. a gallon. In the country, where carriage would be expensive, recourse can be had to the salt made expressly for aquarium purposes, which has become a common article of merchandise, so that it is now quite unnecessary for the aquarium-keeper to measure out the salts himself, as it can be bought ready mixed, and when dissolved in water to the right specific gravity, as directed by the makers, furnishes sea water precisely similar in its properties to that of the ocean itself. The salt necessary is sold by all chemists, and manufactured by Southall Bros. and Barclay. The whole of the water in use at the aquarium in the Aston Lower Grounds, Birmingham (where 200,000 gallons are in constant use), and the water at the Royal Aquarium, Westminster, are manufactured from this salt, a fact which speaks volumes for its efficacy.

CHAPTER II.

THE TANK, AND ITS CONSTRUCTION.

HAVING now enumerated the causes which influence the formation of the aquarium, I shall proceed to give details whereby a suitable tank may be constructed in which to keep the specimens captured. The method of procuring the specimens will be given in a later chapter.

The first item to consider is the material of which the tank is to be constructed. Glass, of course, must enter into its composition, if it is wished to see the inhabitants as they appear to one another, and not simply as when looked down upon from a higher level. At the same time, glass, unless it is used with caution, has unfortunately the disadvantage of admitting too much light. If the tank is made with all four sides of glass, it must be placed in a comparatively dark situation, and this renders it difficult to see the minute details in the structure of its inmates. On the other hand, if made partially of opaque material and partially of glass, the light is kept in check, and the tank can be placed in almost any situation such as an ordinary house furnishes.

At one time it was the fashion to keep aquaria in conservatories; but this is a murderous plan to adopt, for, whatever the construction of the vessel, the light and heat are far too strong in such a situation. The warming of the water will prove almost fatal to the inhabitants, and the glare of the sun on a hot day will complete their destruction. On the other hand, warmth

in moderation is advantageous: the anemones will not open properly if the temperature gets too low. A floating thermometer, for the purpose of ascertaining the temperature of the water at any time, is sold by dealers in aquarium apparatus. Sharp frosts are particularly detrimental to the health of the occupants, and if at all exposed to the cold air, the aquarium should have a woollen covering thrown over it at night. As, however, it is generally kept in a dwelling-room where the fire is lighted during the day, the room seldom gets so cold at night as to render this precaution necessary.

And now as to the manufacture of the tank itself. It is not worth while for the visitor at the seaside to set up a glass aquarium in his lodgings, as it is not convenient to have to convey it home on the return journey. A better plan is to be content with several common, cheap, red earthenware pans, glazed inside, which will answer all necessary purposes, and can be left behind, when returning home, as a legacy to the landlady. The shallower these pans are, the better, but they must be thoroughly cleaned out before putting anything into them. A number of creatures can be kept in perfect happiness in pans of this sort for the few weeks that one is taking a holiday at the seaside. The pans can be rendered more natural abodes for our captives by putting into each a few stones and green seaweeds; but this is not absolutely necessary, as, if the water is shallow, it will absorb enough oxygen from the air.

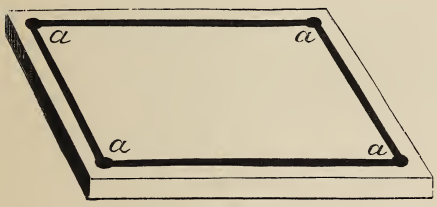

FIG. 1. BOTTOM OF TANK. *a*, *a*, Holes for Pillars.

On returning home, however, something more artistic in its external appearance will be required, and this will probably take the form of a plate-glass tank, with wooden pillars at the corners. Almost any carpenter will construct a good aquarium if an exact description is given him; or if the embryo aquarium-keeper

is a good hand at carpentering, he can make one for himself in the following way:—A slab of slate is procured to form the bottom of the tank, the size of which must, of course, depend on that of the future aquarium; a good size is 1½in. or 2in. thick, 30in. long, and 18in. or 20in. wide. In this slab must now be formed grooves of about ¼in. in depth and breadth, running round the sides at about 1in. distance from the edge (see Fig. 1). Four pillars must be constructed, preferably of birch or mahogany, each 12in. in length, and two grooves, about ¼in. in depth and breadth, must be made down each pillar (as shown in Fig. 2), at right angles to each other. These pillars must be turned off at the end, so as to exactly fit four holes (each about 1in. in diameter, and the same in breadth), which must be made to receive them, at the four corners of the slab of slate, where the grooves join. The pillars are bedded firmly in with cement similar to that described in the next paragraph, and allowed some time to set firm in their places. Next, four pieces of what is known as 32oz. sheet-glass, of the required dimensions to form the sides of the tank, must be procured. These must be bedded firmly into the grooves in the slate and pillars with cement, after which a framework must be made to exactly fit the tops of the pillars and hold all firmly together (Fig. 3). The last touch is given by inserting ornamental knobs at the top of each of the pillars, and the tank is then completed. Its general appearance is shown in Fig. 4.

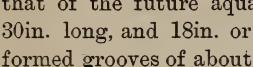

FIG. 2. CORNER PILLAR OF TANK. *a*, *a*, Grooves cut along the Sides.

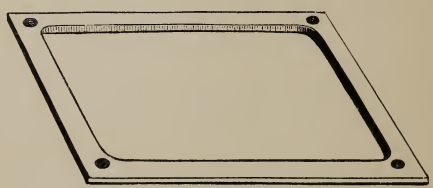
FIG. 3. TOP FRAME.

There are several points of great importance which must be carefully observed in the construction of the tank; neglect of them will be a cause of complete failure, or at any rate of

considerable discomfort to its owner. In the first place, as to the cement, the following is used in the construction of the tanks at the Zoological Gardens, and resists the action of salt water: 2 gills of litharge, 2 gills of plaster of Paris, 2 gills of fine dry white sand, ⅔ of a gill of powdered resin; mix, sift, and keep in a dry place till required for use, when they

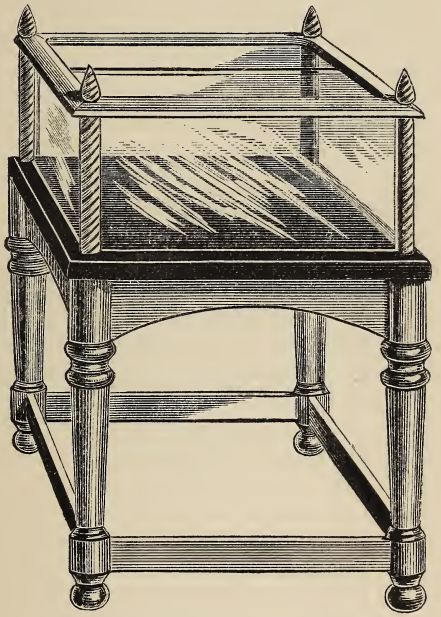

FIG. 4. TANK COMPLETE, ON STAND.

must be made into a paste with a small quantity of boiled linseed oil, to which a little dryer has been added; and the cement must then be used within twelve hours. It will take about a week to dry, and if left for a much longer time, so much the better. A sharp look-out must be kept on the carpenter to whom the job of making the tank is entrusted, to see that he does not use ordinary putty, as

this does not withstand the action of the water in the slightest degree. Another point requiring supervision is the insertion of the glass sides, which are sometimes fastened on by abutments, like ordinary window-panes. This was actually done with a tank in my possession, and the consequence is that it leaks to this day, though every description of cement has been tried to render it watertight. The glass must be set in grooves, and the deeper the grooves, the less chance there is of leakage. The red cement used by ironmongers for cementing taps, pipes, &c., must not be used for an aquarium. It answers well for a short time, when it gives off a most peculiar odour, which contaminates the water, and causes the untimely decease of the whole of the occupants, if they are not removed immediately the smell is perceived.

If slate cannot be easily procured, the bottom of the tank can be made of hard wood, with a piece of glass cemented over it when the tank is put together. The glass will prevent any leakage through the wood which might otherwise take place. The shallower the tank is, the better, for the live stock, not being for the most part accustomed to deep water, but generally being left high and dry by the receding tide, suffer from the stillness and inactivity of the water. It can be made broader and longer than described if a larger tank is needed, but a foot of water is amply sufficient for a marine aquarium.

Mr. Warington, in the first experiments referred to in the introductory chapter, and which appeared in the *Annals of Natural History* for November, 1853, states that he found it best to have the back of the tank of slate or other opaque material; and afterwards aquaria were made with the back and two sides of slate, the front only being of glass. The advantage of these consists in the fact that the illumination comes from the top only, which is more natural, and the risk of breakage from various causes is lessened. At the same time, the confervæ may be allowed to grow on the slate sides and back without molestation, whereas it becomes necessary to frequently clean the glass if that material is used for those parts. Mr. P. H. Gosse, however, does not recommend Mr. Warington's form of tank, as

he considers that it is clumsy in construction, and that the opaque sides and back throw the interior into an unprepossessing degree of darkness. It is certainly much pleasanter to be able to watch the animals in the tank in the holes, &c., in which they secrete themselves, and this cannot always be done from the front of the tank. If the tank is not placed in too light a situation, no evil will result from employing glass as the material for all four sides.

If a tank, as previously described, is considered too troublesome to construct, a very good substitute may be formed by procuring a large propagating-glass, and fixing it in an inverted

Fig. 5. Propagating-glasses used as Aquaria.

position on an ornamental stand. Propagating-glasses can be obtained of very large size, and capable of containing up to twenty gallons or larger. They are not so well suited for seeing objects in the interior as the four-sided tanks, as the circular bend of the glass causes distortion when looked through; they have, however, the advantage that they cannot leak. Fig. 5 shows the method of constructing such aquaria.

Tanks of an hexagonal shape are preferred by some aquarium-keepers; in this case, all six sides will, of course, be constructed of glass.

Tanks are sometimes made with a dark chamber at the back,

which is filled with water, as well as the front and inhabited portion. The advantage of this arrangement is said to be that the water in the dark portion, not being under the influence of light, will keep clear for any length of time, and, by means of a machine specially constructed for the purpose, the water in the inhabited part of the tank can be made to take the place of that in the dark chamber while that previously in the back portion is brought into use. If the water in the front portion becomes contaminated in any way, it is convenient to be able in so simple a manner to replace it with fresh. Besides this, it is claimed that the impure water, when contained in the dark chamber, will gradually recover its purity, and be again fit for use. A section of a slope-back tank, as introduced by Mr. W. A. Lloyd, is shown in Fig. 6.

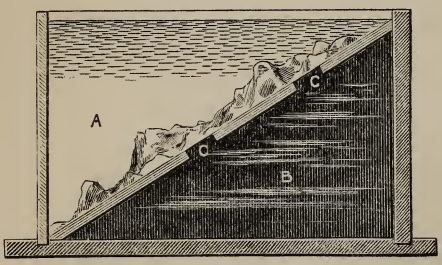

FIG. 6. SLOPE-BACK TANK. A, Inhabited Portion; B, Dark Chamber; C, C, Holes through which the Water Circulates.

My own experiences with a tank constructed with a dark chamber have been the reverse of satisfactory, as I invariably found that the water contained in it became unfit for use, and contaminated that in the inhabited portion of the tank. However, this was possibly due to the cement with which the tank was constructed, which had a greater effect on the shut-up portion of the water, as there was no escape for the emanations given off by it.

It is a good plan, though not absolutely essential, to have a cover made for the tank, in order that dust, &c., may be kept from falling into the water. If a cover is to be added, it should be formed of two pieces of glass of the same breadth as the top of the tank, and each about 1in. shorter than half its length. These should be placed on the top so that there is a space about 2in. wide in the middle between them, in

order that air may be able to penetrate to the surface of the water. Unless the tank is kept in a very dusty situation, they are not wanted, as the dust soon sinks to the bottom, and does no harm to the inmates.

If a little extra expenditure is not objected to, a fountain can be arranged in the centre of the tank, which, by continually agitating the water, will keep the inmates in a more lively condition. The tube from which the jet springs can be hidden in a tall mass of rock rising above the surface of the water in the centre of the tank. It can be fed by a reservoir connected with it by a small indiarubber tube, the reservoir being hidden in a corner of the room, or, if an ornamental vessel is used, placed on a bracket. Of course, the higher the reservoir is, the higher the jet will be, and the more rapidly will the cistern be emptied.

If a fountain is considered too elaborate, a disturbance of the water may be brought about in a simpler manner by suspending over the tank an ornamental flower-pot or bell-glass, with a sponge in the hole at the bottom. The sponge must be perfectly clean, and pushed so tightly through the hole that when the flower-pot is filled with water it will run through in a quick succession of drops. The cord by which the flower-pot is suspended should pass over a pulley, so that by pulling the other end the flower-pot can be hoisted high in the air. Every morning the flower-pot should be filled with water dipped from the tank, and hoisted to its full height. The water then falling from a considerable height into the tank causes a splashing, which is highly effective. If neither of these plans can be adopted, the water can be agitated at intervals with a stick, and syringed occasionally with a glass syringe.

The inside of the tank should receive four or five coats of varnish, to keep the water from rotting the woodwork or becoming contaminated with the lead of the cement. As to its external adornment, this, of course, depends on the taste of the owner. Green and white look very well for a time, but the white soon gets very dirty, and when the tank has been cleaned out a few times it becomes necessary to paint

it again. Nothing looks better than black and gold, or chocolate and gold, as the dark colour of the outside shows off, with great effect, the brilliant greens of the seaweeds and the gorgeous colours of the sea-anemones within.

The aquarium can stand either on an ordinary table, if it is a propagating-glass, or, if it is a square tank, on a specially-constructed stand. If the latter is used, it is not necessary to have a top to it, as the bottom of the tank will form the top when placed in position; this is, of course, assuming that the aquarium and its supports are of similar dimensions (as in Fig. 4). If a smaller tank is to be placed on the support, a top will have to be provided. See that the table is firm and strong in every way.

CHAPTER III.

FITTING UP THE TANK.

THE tank must now be prepared for its future inmates, and in doing this the aquarium-keeper must endeavour, as far as possible, to provide the animals which he is about to introduce with the same conditions of existence that they are found to live under in their natural state.

In the first place, the tank must be thoroughly cleaned; but no chemical substance, such as washing-soda, must be introduced into it on any account. It is extraordinary what a minute amount of any chemical will prove injurious. An aquarium containing several hundred animals has been known to be completely devastated by the use of sea water which had been brought from the sea in a jar, the cork of which had previously been used for a bottle containing some chemical solution. For this reason the aquarium, if constructed of glass and wood cemented together, ought to be left to soak for several days, changing the water frequently; and if left for weeks, or even months, to soak, so much the better. As long as any iridescent or other scum is formed on the surface of the water, it would be fatal to introduce any animals or fishes into it.

When the tank is thoroughly clean, and the water remains free from scum when left in it for some days, the work of preparation may be commenced, by covering the bottom with sand

and shingle. The sand must be that actually found on the seashore; the yellow sand sold by grocers must on no account be used, as it will discolour the water, even after the most thorough washing. If burrowing creatures are not to be kept, the sand, if difficult to obtain, may be omitted, and a large quantity of shingle used instead; but a tolerably good substitute for the sand is ordinary sifted gravel, which must be washed under a tap turned on full for a long time, stirring it up at intervals with a long stick until no muddiness is caused by the disturbance, the water running off perfectly clear. This gravel should be laid on the bottom of the tank to a depth of about 2in., and on it a layer of coarse shingle (also well washed) to a depth of another inch. If a propagating-glass is used, it will be necessary to put sand and shingle up to the point where the sides are vertical, as, if they do not reach the bend, it becomes difficult to see any animal resting on the shingle.

The next thing to be inserted is the rockwork, of which some should be placed close to the glass, and some receding towards the back of the tank. The artistic feeling of the operator receives ample scope in this part of the work. A pretty arrangement is a little bay in front, with rocks on each side joining the main body of rockwork at the back of the tank. One or two pieces of flat rock should be built up so as to stand above the level of the water. This arrangement is made for the use of many marine creatures which prefer to pass a small portion of their time out of the water. Of course, the more little nooks and crannies, arches, and such like, are made with the rockwork, the more natural it will be. Some creatures prefer to pass their time in caves, and only come out occasionally to eat, &c.; these should, accordingly, be accommodated with caves, constructed by a suitable arrangement of the rocks.

The stones of which the rockwork is composed must be rough, and as artistically shaped as possible. If suitable stones are not to be found, pieces of artificial rockwork can be obtained from aquarium-dealers; but this cannot be recommended if anything else of the kind is at hand. If the sides and back of the tank are constructed of an opaque substance instead of glass, the

interior can be differently arranged, and the sides made to imitate the interior of a rocky cavern, by being covered with Roman or Portland cement, which hardens under water. This can be moulded, while still plastic, into artistic shapes to represent rocks, &c. Branches of coral can be inserted into it while moist, and will stand out in a natural manner when the cement is dry. Small crevices should be left in the cement at intervals, into which stones, with seaweed growing on them, can be dropped after the cement is dry, the seaweed thus presenting a very natural appearance. If the stones have been previously used for a fernery, and mosses, &c., have grown on them, the earth and green mould on them must be thoroughly scrubbed off before placing them in the tank. The kind of stone also deserves attention. Perhaps some of my readers may have access to glassworks, and may be tempted to use the "clinkers" therefrom; but these, although suitable in appearance, should not be used, as experience has shown that the water dissolves substances from them which are injurious to the live stock.

Before filling the tank with sea water, it becomes necessary to select the position which it is to occupy, as when filled it will be too heavy to be conveniently lifted. Now, there are generally several positions at the disposal of the aquarium-keeper, and in nine cases out of ten he selects the very worst that can possibly be found. The seaweeds with which the tank is to be stocked have the power of generating an innumerable quantity of spores, which settle on the sides of the tank, and obstruct any view of the interior. If the aquarium is put in too light a situation, these spores are generated with such extreme rapidity that not only does the glass become covered with them, but even the water is rendered thick, like pea soup. Beyond the fact that any sight of the animals is thereby rendered exceedingly difficult, no harm is done, as the inhabitants of the tank are not at all affected by this condition of the water; but as it is desirable at all times to see the conduct of the inmates, it is as well to guard against this state of things as much as possible. To avoid the evil, keep the aquarium, if wholly constructed of glass, in a dark situation—that is to say, no direct sunlight must shine on the water,

unless very early in the morning or just before sunset. If the water at any time gets into the pea-soupy condition mentioned, it need not be thrown away; but if kept for a week or two in a vessel with opaque sides, or in a cellar or other dark place, the green algæ will soon disappear, and the water regain its former clearness. If the aquarium has glass sides, and must be kept in a light situation, it is a good plan to have light wooden shutters made to fit the sides, outside the glass, which can be put up when the sun is shining on the tank. It may also be covered with a newspaper, or anything similar.

The rockwork must be thoroughly cleaned, by being scrubbed with a hard brush, and well washed in several changes of water. When this has been done, and the stones built up as before described, the sea water must be introduced in the following way: Two thick pieces of board are placed across the top of the tank, so as to leave a space between them. On the top of these boards is placed a large flower-pot, with a thoroughly-cleaned sponge in the hole at the bottom, in such a position that the flower-pot is supported by the boards, while the sponge hangs down between them. The sponge must be squeezed tightly into the hole, so that when the water is poured into the flower-pot it will run through into the aquarium in a fine stream.

As long as the aquarium-keeper is by the sea it is, of course, best to use water from the ocean, but in the country inland it is far less trouble to use Southall's Aquarium Sea Salt. Tidman's should not be used, as this is not made for aquarium purposes. The former may be obtained from any chemist, and is easily mixed up for use according to the directions given with it. For aquarium purposes, however, the specific gravity must be adjusted by means of "specific gravity bulbs" (Fig. 7), to be obtained from the chemist where the salt is purchased, or from an aquarium-dealer. They must be adjusted for sea water of the proper density. To show when the correct amount of salt has been added, the bulbs are allowed to float about in the vessel. If the blue (or brown) one floats at

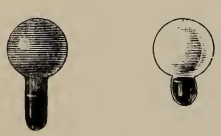

FIG. 7. SPECIFIC GRAVITY BULBS.

the top, it is too salt, and more fresh water must be added; if the white bulb sinks to the bottom, it is too weak, and more salt must be added. When the right strength is obtained, the white ball will float at the top, and the blue one will sink to the bottom. A good way to mix the salt is to empty the box into a can of hot water, and leave it till dissolved, stirring at intervals. This strong solution can now be poured into another can, and adjusted to the right strength with fresh water. The water is now to be filtered into the aquarium by pouring it into the flower-pot, and allowing it to run through the sponge in a fine stream. If it runs through too fast, the sponge must be squeezed more tightly into the hole. It is important that it should run through slowly, not only because by this means it is filtered more thoroughly, but also because in its passage through the air in a fine stream it takes up a large quantity of oxygen, and is thereby rendered more fit to support the life of the future inhabitants of the tank.

CHAPTER IV.

COLLECTING.

IT is perfectly possible to set up an aquarium containing every description of anemone, fish, and annelid, without going out of London to procure them, for as these creatures are now articles of extensive merchandise, and are sold over the counter like any other goods, nothing more is required than to go to the right shop, pay the money, and bear away the desired specimens. In the case of the more uncommon and delicate objects this is sometimes to be preferred, inasmuch as one may hunt for years, without the dredge or similar instrument, and not find a species which is obtainable in abundance by its means, and is therefore cheap to purchase; and delicate species are more likely to live when bought inland, as they have become inured to captivity in the dealers' tanks.

The individual who sets up his aquarium in this way, however, foregoes at least half of the pleasure to be gained from it. It is to be hoped that many who set up an aquarium do so, not merely for the pleasure of creating a pleasing ornament, but also from a desire to form an acquaintance with the habits of the creatures within it. Now, by hunting for the desired objects one's self, not only is an interesting occupation furnished for leisure moments, but an insight into the habitations of the inmates of the ocean is obtained, which is certainly to be gained in no other way. There are few occu-

pations so interesting as searching for marine specimens: the discovery of many of them is so unexpected; and it is so charming to meet with the objects in a real living state which one has only hitherto read of in books. Moreover, the imagination is kept continually on the *qui vive* as to what will turn up next, and from one moment to another one does not know whether a most unexpected and long-wished-for prize may not fall into one's hands. And therefore I would strongly recommend all those who wish to set up an aquarium to go and hunt out the creatures for themselves; and if they wish for rare specimens, or those whose habits preclude search being made for them, the dealers can then be resorted to.

The first thing to do when it is wished to capture the specimens one's self, is to choose a suitable locality; and though, unfortunately, the aquarium-keeper cannot always be sure of meeting with the sort of coast required for shore-hunting, still, if a visit is planned without any special destination being fixed on, the following notes on favourable hunting-grounds may guide his search. It would seem from Mr. Gosse's books on marine zoology, that the Devonshire coast is particularly prolific in marine specimens. Torquay, Ilfracombe, Sidmouth, and Plymouth, are well-known localities, and many species may be found at Margate and Ramsgate; while Weymouth has the reputation of being the most prolific spot of all for colonies of the *Actinoloba dianthus*, which is said to exist in large families in the offing. On the Cornish coast, Falmouth and Penzance are favourable hunting-grounds. Kynance Cove, about one-and-a-half miles from Lizard Head, and not far from Falmouth, has a particularly good reputation as a locality for rare specimens. In the island of Sark are the famous Gouliot caves, which are only accessible at extreme low tide, and are celebrated for being stocked with numerous species of anemone, some of which are of the rarest kind. Guernsey and Jersey are also prolific localities. In any case, a sandy and shingly beach is practically useless for the purpose. What is wanted is a place where large rocks abound, and form tide-pools, which are filled by the sea at high water, and left within easy reach when the tide is down. In these tide-pools

many marine creatures reside, and are easily captured, being in a comparatively limited space. The kind of rock also has an enormous influence on the value of the coast to the naturalist. Chalk rocks, such as abound in the Isle of Wight, are very unsatisfactory. The most suitable coast is one on which gigantic boulders of granite are plentiful, and this is especially the case in Devonshire and Cornwall. As to the tide, so much depends on this that the following information should be laid well to heart. Low water is, of course, the time for shore-hunting, as few creatures live in situations where

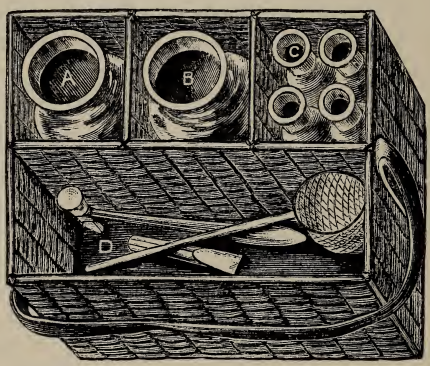

FIG. 8. COLLECTING-BASKET.

they are exposed for a long time to the sun and air. The nearer to the water's edge the hunter can approach, the richer will be his harvest, and the more valuable his finds. The time to be aimed at is, therefore, the lowest water at what is known as the spring tide, when the water is withdrawn to its furthest limits. Spring tides occur twice in every month, about the time of the new and full moon. The best tides for the purpose are on the second day after the change of moon, and for a day or two afterwards the tide goes out further than it usually does. Full-moon tides are more effective than new-moon, and the tides which occur at the time of the equinoxes

—that is, the spring tides of March, April, September, and October, are also lower than those at other times.

When starting on a collecting expedition, it is necessary to take a supply of implements with which to capture the wished-for specimens. To hold them, a wickerwork basket should be taken—one with a flat bottom and straight sides is preferable. This can be divided into compartments in the following way (as shown in Fig. 8): In the divisions A and B are placed two glass marmalade-pots, and in C four small, wide-mouthed phials; while the implements are placed in the space D. The jars in A and B are for large specimens, anemones, &c., which must be kept in water. In the wide-mouthed phials in C are placed small specimens. In the fourth division (D) are placed a geologist's hammer, to chip off pieces of rock on which are anemones, weeds, and what not — this hammer should have a cutting-edge as well as a striking-face, as shown in Fig. 9; a chisel, which must be what is known as a cold chisel—*i.e.*, made entirely of steel; a small net, made of the material known as "leno," which must be rendered limp by soaking in boiling water, with which to catch the finny denizens of the pools. This division is also useful for containing seaweed, shells, crabs, and other objects to which a temporary sojourn out of water will do no harm.

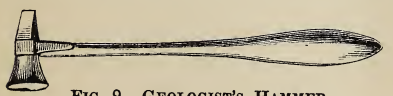

FIG. 9. GEOLOGIST'S HAMMER.

The enthusiastic beginner must not be disappointed if he finds his first few excursions by no means so productive as he expected. The art of searching for specimens in their natural habitations is one which can only be acquired by practice. An experienced hunter will return with his basket full of valuable specimens from a hunting-ground which a novice had previously gone over without noticing anything worth picking up. Both eye and hand need considerable practice before they learn to recognise objects with which they have formerly been acquainted only in books; and even if the hunter has studied the appearance of the specimens in a public aquarium, he will be surprised to find how totally different the same animals

look when found in nature. A mere cursory investigation of the rocks is of no use—every crevice and cranny must be thoroughly searched if his labours are to be rewarded with success. He will soon find how much sharper he is getting after a few days of such work; his eye and hand, being trained to their new occupation, will at once take notice of symptoms of animal life which at first would have been passed over, resulting in the acquisition of more uncommon specimens. To guide his first endeavours the following notes will be of use.

The place where most specimens abound is a point where a long line of rocks runs right out into the sea. Here will be found crevices covered with Bladder-weed (*Fucus serratus*, Fig. 10). Take care how you walk, as walking is rendered very difficult, not to say dangerous, by the weed, which not only is so slippery that it becomes difficult to keep one's footing, but conceals crevices in the rocks, often of considerable depth, into which the unwary hunter steps, thinking it solid rock; and in this way a sprained ankle is easily acquired. Boots render it harder to stand, as they slip over the weed; but socks should certainly be worn, as the sharp edges of the barnacles, with which the surfaces of the rocks are covered, are terribly lacerating to the feet and hands, and sometimes inflict severe cuts if the rock is grasped on finding oneself in the act of falling into a hole. I have sometimes had scarcely any of the skin left on my hands after a day's shore-hunting! For all that, it is most absorbing work, and it is worth a little extra trouble to get a glimpse of the animals as they actually appear when in their natural condition. It is, perhaps, as well to warn the enthusiastic naturalist to keep a sharp look-

FIG. 10. BLADDER-WEED (FUCUS SERRATUS).

out all the time on the returning tide. If he is engrossed in his pursuit, and neglects its advance, he may suddenly find himself in an unpleasant or highly dangerous situation, the coasts which are particularly suitable for shore-hunting being of just the kind which are most dangerous to a collector

FIG. 11. COMMON CORALLINE (CORALLINA OFFICINALIS).

caught by the tide. If the hunter follows the tide as it recedes, he will have a period of several hours before it is likely that he will be overtaken by its return.

All masses of hanging seaweed should be lifted up and examined, for underneath them may be found several species of red seaweed, the beauty of some of which may

tempt the beginner to give them a temporary place in his tank. In pools near low-water-mark may often be found the extraordinary plant known scientifically as *Corallina officinalis* (Fig. 11), which resembles little bushes of jointed twigs, hanging from a rock over the edge of the pool. When living it is of a dull purplish tint; if white, it is dead. I have kept specimens of this weed for some time; they do not do much harm if they die, as there is very little vegetable matter about them. The *Ulva latissima* (Fig. 12) can be found in abundance in hollows and fissures between rocks. It frequently grows right up almost at high-water level, as it does not object to being left by the tide during the greater part of the day. In the same pool will probably be discovered the *Enteromorpha compressa* (Fig. 13) and the *Zostera marina*, another green weed, with feathery branches, which may be kept for a while in the tank.

FIG. 12. SEA-LETTUCE (ULVA LATISSIMA.

FIG. 13. SEA-GRASS (ENTEROMORPHA COMPRESSA).

If the naturalist not only cares for collecting specimens for an aquarium, but is also interested in observing their habits in nature, there is an instrument known as the water-telescope which is constructed for the express purpose. In looking into a large pool, and more especially on the sea itself, it will be found that the great obstacle to observation is the continual ripple on the surface of the water. This ripple is avoided by the use of the water-telescope. The

instrument is exceedingly easy to construct. It consists of a tin or zinc tube about 3½ft. long, at the bottom of which is inserted a plate of sheet glass; and some ornamental pieces of lead must be fastened outside, at the end, to keep it sunk beneath the surface of the water when in use. On a bright day, when the water is clear, the observer can see from three to twenty fathoms with this instrument. Cornishmen at the Land's End use the water-telescope to discover lobster-pots, &c., which have been lost. The obvious advantage of the instrument for our purpose is that the animals are seen when thoroughly at home, before they have been disturbed by removal to the aquarium.

Sea-anemones are generally found in crevices; but some hardy species, as *Actinia mesembryanthemum* (Fig. 14), are sometimes found fully exposed to air and sun. On the other hand, some species frequent very dark holes in the rocks, and occasionally the aggravating experience has to be gone through of finding a particularly fine and handsome specimen, or perhaps a whole colony, just beyond one's reach, and, as nothing short of the human hand will remove them, their capture has to be reluctantly abandoned. The best way to get anemones off the rock is by slipping a paper-knife under their bases; but if the rock is too rough to admit of this being done, they will have to be loosened by a judicious use of the finger-nail, care being taken not to tear the base, which is their most vulnerable point.

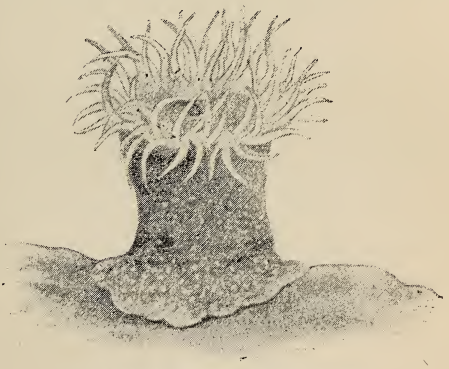

FIG. 14. BEADLET ANEMONE (ACTINIA MESEMBRYANTHEMUM).

Turn over all loose stones, especially those of moderate size, close to the water's edge at low tide. Under them may

frequently be found specimens of the Nudibranch Mollusca and crabs, especially the Hairy Broadclaw (Fig. 15).

Molluscs abound everywhere, in weeds and on rocks. Barnacles are easily found, and, indeed, are far too common for the comfort of the collector. The largest specimens should be chosen for the aquarium, and if they can be found attached to small stones which can be placed entire in the tank, so much the better.

FIG. 15. HAIRY BROADCLAW (PORCELLANA PLATYCHELES).

Dredging is by far the most productive method of obtaining marine objects, and there are many species which can only be obtained in this way. The net used in dredging is modelled on the familiar oyster-dredge, but has both sides of the frame formed into a lip instead of only one (Fig. 16), so that on whichever side it falls it will be equally effective. The net itself is made of spun yarn, or small, strong string, netted with fine meshes. To the two ends of the frame are fastened two strong pieces of rope, which meet together in front. The dragging-rope is fastened to the centre of these with a swivel joint, to keep it from getting twisted; it must be a very long rope, about three times as long as would be necessary to drag the dredge along perpendicularly under the boat, the reason being that, unless a considerable length of tow-rope is allowed, the dredge will

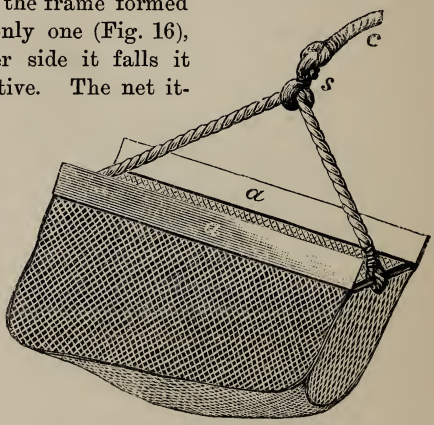

FIG. 16. DREDGE FOR BOTTOM COLLECTING. *a*, *a*, lips; *s*, swivel; *c*, cord.

dance along the bottom in a succession of jumps, and miss half the treasures it meets with. If the locality is favourable, a multitudinous variety of objects will be collected by the dredge—crabs, serpulæ, molluscs, anemones (including the Plumose, Fig. 17), worms, fishes, sponges, seaweeds, &c.; nothing comes amiss to it, and selection must be made from each haul of those most suitable for the aquarium.

FIG. 17. PLUMOSE ANEMONE (ACTINOLOBA DIANTHUS).

A common shrimping-net will secure numbers of small fishes, &c., if used in the ordinary way. The flat fishes lie underneath the sand, and are not visible, but the net passes through the sand, and engulfs them all in its embrace. Unfortunately, these fishes, though so easily procured, are very difficult to keep in the tank, at least according to my own experience.

Now, a word with respect to the transportation of marine specimens. If they will not bear removal from the water, the only way is to put them in a stone jar, half-filled, and send them, labelled "Immediate," by passenger train. Every hour they spend in transit adds greatly to the risk of finding most of them defunct on opening the jar, for which reason arrangements should be made to render their journey as short as possible by sending by express train, and having them met on arrival. The bottle should not be more than three-parts full of water, so that there may be plenty of splashing caused by the motion of the railway carriage. This causes the water to absorb the oxygen of the air above it in the jar, and so keeps it comparatively fresh. The cork of the jar should

have a small piece of glass tube passed through it, communicating with the air on both sides, by which means it will be kept fresh; and even if the jar gets turned over on one side, the water will not escape. Seaweeds and stones must, of course, go in a separate box, as their knocking about inside the jar would be tolerably certain to injure the animals.

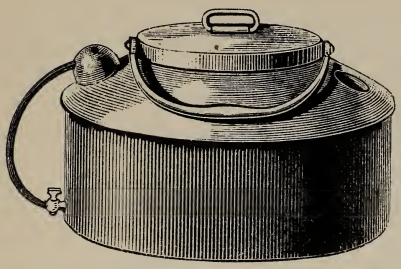

FIG. 18. CAN USED FOR THE TRANSMISSION OF FISHES, &C.

In the "Natural History of British Fishes," by the late Frank Buckland, an apparatus is described which he considered the best for carrying fishes on a journey when one can accompany them one's self; and as this can obviously be utilised for marine specimens of all kinds, and is therefore interesting to my readers, I describe it here. Fig. 18 represents the external appearance of the can, and Fig. 19 a section of it. The invention is a German one; it consists of a can with a false bottom (E), made of perforated zinc, beneath which is a bent pipe, traversing round inside the bottom of the can, and likewise perforated. To the outside end of the pipe is attached an indiarubber tube (B), and a ball (A) of the same material. By squeezing the ball (A), air is pumped into the can in a continual stream. A stop-cock is provided at D, and a funnel at C. One great advantage of this contrivance is that the apparatus can be placed under the seat of the carriage in travelling, and

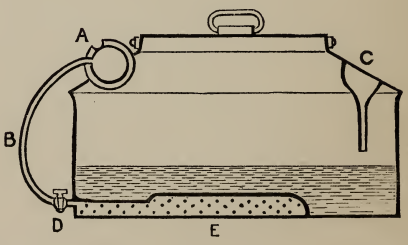

FIG. 19. SECTION OF CAN USED FOR THE TRANSMISSION OF FISHES, &C.

the ball can then be worked with the feet, while one is comfortably reading.

The Parcel Post has, however, opened out a way by which sea creatures of all sorts may be sent from the coast inland with the greatest possible ease. If the aquarium is limited to those creatures which can be sent in this way, no harm will be done, as nearly all marine specimens will travel with perfect safety between layers of wet seaweed. I have had quantities of anemones, crabs, and even fishes, sent me from the sea simply packed in moist seaweed. Stones, as before, must, of course, be sent separately. First put a layer of refuse seaweed at the bottom of the box—*damp*, not *wet*, as, if the water runs out of the box, the risk will be run of getting into trouble with the postal authorities. On this put the seaweeds which are to be placed in the tank, attached to minute bits of rock; on these put the animals, fishes, &c.; then another layer of seaweed for use, and another of refuse weed. Then fasten down the box, and commit it to the charge of the Post Office.

On receiving a box of live stock, have several basins containing sea water at hand, and when the box is opened put the fishes into one, the anemones into another, and the weeds into a third. Beware of placing objects of a doubtful kind into the tank; give them a day's quarantine in a shallow basin, and then insert them, if they appear well. With these precautions, the creatures which did not show to advantage on arrival—the anemones especially looking like lumps of suet or jelly more than living things—will resume their wonted appearance in the course of a few hours, and by the next morning will probably have made themselves quite at home in their new position.

Some difficulty will be found in getting the anemones to adhere to the rocks in the desired position. As a general rule, they are most perverse, and prefer to roll about at the bottom of the tank for some days without adhering to anything. They should be prevented from crawling up the glass, as it necessitates their removal when it has to be cleaned; but if one does so during the night, the opportunity should be taken of examining the base with a lens through the glass. It will be seen that there is a centre point corresponding to the mouth in the

disk, from which lines radiate to the circumference. The anemone moves by loosening one side of the base, and moving it on a step; it is then fastened again, and the other side is loosened, and moved on a step. This side is then fastened again, and the other side is again loosened and moved on a step in the same direction, and so on. The action is somewhat similar to the motion of the caterpillars belonging to the *Geometridæ*, or Loopers, but incomparably slower.

Sometimes an anemone, instead of attaching itself to a solid foundation, will be found floating about at the surface of the water in an inverted position. This is done by forming the base into a sort of boat, which, as long as it remains dry, supports the anemone at the surface of the water. If the water is made to fill the cavity, the anemone sinks at once. When it gets tired of this behaviour it will attach itself to a rock in the ordinary manner. The species known as *Sagartia troglodytes* is especially noted for this peculiarity; it sometimes passes several months floating on the surface of the water of the aquarium, if not disturbed.

CHAPTER V.

FOOD AND FEEDING.

THE aquarium is now fully established, and for the first time since the commencement of his labours the owner begins to feel the satisfaction which is the reward of his toil. He will probably be vastly delighted with the appearance of the tank for the first four or five days; for there are few objects so gorgeous in colouring and so picturesque in general effect as a tank lately stocked with its full complement of seaweeds, anemones, &c., the background of arches and caves formed by the rockwork lending an additional charm. He must not, however, be dismayed if he find a good many of his stock do not survive the ordeal of domestication; some will be sure to die in the first twenty-four hours or so, some in the course of the first week; but those which live over the first ten days or a fortnight may be considered acclimatised, and will probably continue to exist happily in the tank for years.

If the aquarium-keeper lives at a seaside place, it will not be absolutely necessary to feed the animals at all, as in that case he will naturally use real sea water; this contains myriads of minute infusoria, on which most of the inmates of the tank subsist. The supply can always be renewed at pleasure by picking up small pieces of feathery seaweed on the shore and dropping them into the tank, removing them again in a few hours' time. The infusoria among the branches of the weed will speedily swarm out into the water, and be devoured by

the fishes, &c.; if this is done at night, and a lighted candle is placed outside the tank, close to the glass side, the minute animalcules will be plainly seen to swarm out of the weed, attracted by the light. The fishes, moreover, will soon see the object of this arrangement, and will prepare for a good meal as soon as they see the light.

When far from the sea, and using artificial sea water, it will be necessary to find some other nutriment for the occupants, as there will not be any great number of infusoria in the home-manufactured water, though a good many will be found in it by the aid of a microscope, having been introduced with the seaweeds and animals. And here I may make a digression, in order to point out that the seaweeds introduced should be thoroughly washed in a little clean water before being placed in the tank. If this is not done, they are liable to render the water very thick for some days with the mud and sand which is contained between their fronds. It is especially necessary to wash the weeds thoroughly when they have been sent by post or rail, as small pieces of rock rubbed off in transit will then be found adhering to their fronds, and must be removed before placing them in the tank. All sponges must be scraped off the stones, or they will certainly die, and pollute the water, thereby rendering it unfit for the other creatures.

The best substance on which to feed nearly all the inmates of the tank is raw meat—either mutton or beef—cut up into very small pieces. It is amazing what a large quantity of this will be devoured by some creatures. I once kept an eel that used to devour eight or nine moderate-sized pieces at a meal. The anemones will consume a good many pieces, and a very interesting process their method of eating is. The way to give meat to an anemone is to press a small piece tightly on to the end of a long stick, and push it downwards till it comes in contact with the tentacles of the creature, to which it will instantly adhere firmly, so that the stick can be withdrawn, leaving the morsel in the clutches of the anemone. Long, wooden forceps are sold by the dealers for the purpose of feeding anemones, &c. If watched, it will be seen that one tentacle hands on the meat to the next, so that it soon

reaches the mouth in the centre, in which it is speedily engulfed. The anemone does not at all object to having several pieces given to him at the same time, at different points on his disk. They will all be held firmly by the tentacles, and devoured one after another. If the meat will not adhere to the tentacles of an anemone, it is a sign that that specimen is not hungry. Anemones appear to have the power of making their tentacles adhere or not as they choose.

In the case of the Plumose Anemone (and also with a few others, such as the Daisy) another plan must be adopted, as, if a piece of meat were dropped on to the tentacles of an expanded Plumose, he would instantly collapse, the slightest touch being enough to cause him to shut up. If it is dropped into the centre of his disk, so as not to touch the tentacles, he will swallow it in a few minutes, and, indeed, the Actinoloba has a remarkably good appetite, and will dispose of several large pieces at a meal, after which, especially if the room is dark, he will expand in all his glory, and present a splendid and astonishing spectacle to the eyes of an unaccustomed observer. There is really no other anemone that will bear comparison with the *Actinoloba dianthus* in point of magnificence, though many surpass it in gorgeous colouring. From this fact it was known until recently as *Actinia pulcherrima*. The reason why the tentacles in this anemone do not grasp the meat when presented seems to be that it belongs to the order of *Sagartiadæ* (it is sometimes called *Sagartia dianthus*), and consequently does not kill its prey by holding it with its tentacles, but by means of the acontia, which are shot forth in quantities if the creature is roughly handled. It is rather difficult to see how the victim is afterwards taken into the mouth of the anemone; those that I have kept made no effort to devour anything not actually put on to their disks; indeed, it is surprising that a creature so sensitive to the lightest touch as the Plumose is, can survive the rude shocks which it must constantly receive from its expiring victim. The acontia frequently get torn off; but, as the anemone remains in good health, they do not seem of vital importance to it.

The fishes can, of course, be fed by simply dropping the pieces of meat into the water. An exciting scuffle will sometimes occur when two of the boldest take a fancy to the same piece. Blennies and gobies will soon become tame enough to take pieces from the hand, or come out and fetch them if placed on the top of a rock above the surface of the water.

The madrepores will eat the same food as the anemones, and in a precisely similar way. It must, however, be cut very small for them, as, not being able to expand their calcareous plates in the way that the anemones do their soft tissues, they cannot accommodate themselves to the size of the pieces offered them.

Most species of crabs are very voracious; indeed, it is hardly possible to give a Green Shore-crab more than he will eat; and if he does not get enough to satisfy his appetite, he will not scruple to devour one of his neighbours, if he can find one that has just cast his shell, and is, therefore, unable to defend himself; or a small crab of his own sort, if there are any in the same vessel with him. The most exciting contests occasionally take place if one piece of meat is dropped into a dish in which are a lot of hungry crabs. Every crab in the dish will instantly make for it, and a general scuffle will ensue, a claw or two sometimes getting pulled off in the battle.

It is by no means necessary to feed the animals daily, and in this respect they are more easily kept as pets than birds, rabbits, &c. With the inmates of an aquarium, food is by no means so essential, and sometimes they will voluntarily refuse to eat anything when offered them for some days. Even the fishes will live in perfect contentment for weeks without anything to eat, though they will nevertheless make a good meal when it comes in their way. It is decidedly objectionable to feed them too often, as the rejected morsels will cause turbidity in the water if they sink behind rocks, &c., whence they cannot be removed. At the same time, if the anemones are not fed occasionally, they are apt to become dissatisfied with their position, and

unfasten themselves from the rock in hopes of finding a more prolific situation.

If the anemones are wanted to "show off" at any time, they can easily be made to expand to their utmost by giving each a very small piece of meat. In about half an hour they will all be widely expanded in expectation of a further meal. All pieces of meat not swallowed by anemones or crabs, and pieces ejected after all the nutriment has been extracted, must be at once removed from the tank. If this is not done, they will cause utter destruction to descend on the living beings in the tank, by decaying in the water, and thus rendering it unfit for their respiration.

The molluscs will, of course, feed on the seaweed growing on the stones and the glass sides of the tank. They rarely devour any of the larger leaves, apparently preferring the young growth; and as they thereby keep the glass clean, the aquarium-keeper has every reason to encourage them in their taste.

The oysters will extract food for themselves from the water as it flows through the tubes with which Nature has provided them. If the water in the tank is slightly turbid, on looking at the oyster a current will be clearly seen entering at one tube and issuing from the other. The oyster assists in keeping the water clear when it turns of a greenish colour and becomes nearly opaque. A few words more may not be out of place on this important subject.

Turbidity in the water of the aquarium may be caused by one of two evils. If it is not evenly distributed throughout the tank, but forms in clouds here and there of a white or greyish colour, which, when the water is agitated by stirring it up, are dispersed for a time, though presently forming again in another place, this is caused by the presence of an immense multitude of animalcules belonging to the tribe of infusoria, which, if a drop of the water is placed on a slip of glass under a microscope, and examined, will be seen moving gaily about in all directions. This shows that there is a dead animal somewhere in the tank, and it must be at once searched for and removed. The animalcules do no harm in themselves,

but if the defunct animal is a very small one they will have devoured it (the object of their appearing being to feed on the carcase) in a few days, and will then themselves disappear, leaving the water clear and bright as before. If, however, the animal is of moderate size, and the body is not removed at once on the presence of the animalcules being perceived, they will increase to such an extent that the water will become thick and putrid, and every animal in the tank will certainly perish.

The other kind of turbidity is of a totally different appearance. The water, which was previously clear and translucent, suddenly becomes of a light green colour, and very opaque. There is no counting on the appearance of this evil, for I have had a tank, the water in which has been perfectly clear for months, and in a single day has suddenly become the colour of pea-soup, and so opaque that no animal whatever in it could be seen unless quite close to the glass.

A very much higher power of the microscope is required to unravel the cause of this phenomenon; but if a very high power is used, it will be seen that the water is crowded with minute bodies of an oval shape. These are, probably, the spores of some green Oscillatoria, or similar plant, as there are generally more of them in a tank which contains specimens of these weeds. This state of the water does no harm whatever to the inmates of the tank, which will continue to carry on their usual movements with complete indifference; it is, however, an abominable nuisance to the owner, who is completely deprived of all opportunity for watching his pets. The use of the slope-back tanks with dark chambers is here apparent, since the water becomes clear if put into a dark place. Light is essential to the growth of the spores, and if they are deprived of this they will speedily die away again, and the water become clear.

In the second state of turbidity the oyster will render good service in clearing the water; but one cannot do much good single-handed, and if more than one is kept, they will require a large volume of water for respiration, so that they cannot be utilised to a very large extent.

How the anemones digest their food is somewhat of a mystery. That the meat is altered in some way during its sojourn in the interior of the Actinia is evident, as when ejected again it is of a white colour, and the "goodness" has evidently been extracted. If left in sea water, and not swallowed by an Actinia, it does not undergo the same change, and yet the most rigorous tests have failed to discover within the anemone any liquid corresponding to the gastric fluid of the higher orders of life. In Mr. Lewes' "Seaside Studies" an interesting series of experiments is detailed, to which I can refer those interested in the subject. The experiment was tried of giving the anemones small pieces of blue litmus paper, together with the pieces of meat. Had there been any acid fluid in the digestive apparatus of the anemone, the litmus paper would have been turned *red*; but as it was not so, the only conclusion that can be drawn is that the acid fluid does not exist. Yet that the meat is acted on in some way is evident from the fact that the weight is considerably reduced, 11gr. being in one experiment reduced to 5gr., and 7gr. to $3\frac{1}{2}$gr. It seems, then, that the anemone has some means of assimilating the nutritive portions of the meat, though it is not known exactly how it is done.

CHAPTER VI.

GENERAL MANAGEMENT.

VERY few utensils are required for the general management of the tank, and they are so simple in construction that anyone can manufacture nearly all of them for his own use. They consist of:

(1.) An indiarubber tube, to be used as a siphon for emptying the tank in cases of necessity. This can be procured from an ironmonger. About 3yds. will be enough for all purposes, and it should be about ¾in. bore. When bought, the probability is that it will be found filled with wire, the object of which is to keep it expanded. The wire, however, does more harm than good, and will have to be removed from the tube, as the sea water rusts it, and after this the tube cannot be used, rust being particularly fatal to marine animals. It is better to remove the wire at once, before the tube is used, for if it once gets rusty, it may possibly break off in the middle of the tube, and leave the owner in an awkward predicament.

(2.) A sponge attached to the end of a long stick, as in Fig. 20. This is for the purpose of removing confervæ from the sides of the glass. However carefully the molluscs carry out their duties in mowing down the

FIG. 20. SPONGE ON STICK, FOR CLEANING SIDES OF TANK.

green stuff, a certain amount of it will be left on the glass. It is necessary to remove this in order to see properly through the glass, and for this purpose the above instrument is necessary.

(3.) A small net—or rather two, for it is best to have one very shallow with which to remove rejected morsels of meat and dead bodies, when this duty becomes necessary. This net need not be a large one—2in. in diameter and ¼in. deep is amply large enough. The other is deeper, say about 4in. in diameter and 2in. deep (Fig. 21). This is used for catching lively creatures, such as eels and other fish, when the water has to be turned out of the tank. Both nets are best constructed of fine muslin, sewn round rings of galvanised iron wire, attached to long, thin sticks. They will need renewing pretty frequently, as the water soon rots them away.

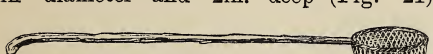

FIG. 21. NET FOR CATCHING SMALL OBJECTS.

(4.) A glass syringe, which can be obtained from a chemist. One capable of holding 3oz. of water when full is quite large enough.

(5.) A large flower-pot, with a sponge to fit the hole, as used to filter the water into the tank, and described in Chapter III. There must also be provided two pieces of stick long enough to go across the tank, to hold the flower-pot above it, and strong enough to bear its weight when full of water.

(6.) A large earthenware jug or basin—if possible, large enough to contain the same volume of water that the tank holds.

Most of these utensils are essential, as, sooner or later, it will become necessary to change the water in the tank, and put fresh in its place. When this has to be done, either from a number of deaths occurring among the live stock, thereby rendering the water unfit for use, or from a too great increase in the spores of the weeds, the first thing to do is to empty the tank by means of the indiarubber siphon. One end of the siphon having been placed in the water,

and the other in a can on the floor, it is made to work by sucking the end which is in the can. When once the flow has been started, the water will go on running until the tank is empty, if the end in the tank is kept under water. When it is wished to stop the flow for a time while the can is being emptied, pinch the lower end, and it will then start again when released. If the upper end is taken out of the water, the lower end will have to be sucked to start it again.

The sucking process requires practice. It is decidedly best to experiment on a vessel containing clean water, as it is probable that in the first few trials, if care is not taken, the water will get into the mouth of the operator, which is a most unpleasant thing to happen if it is in a very dirty condition. It will soon be found that, if the sucking is carried out properly, the siphon can be started without a drop of water entering the mouth—that is, the siphon must be exhausted of air, and when the water is felt to have risen above the bend, the end removed from the mouth before the water has time to run out.

There is another way of starting the siphon without sucking it, which, though it is rather complicated to describe, is very easily carried out in practice. Take a vessel full of water, and lower the siphon slowly into it, coil upon coil, until the whole of it is under water; this drives all the air out of it, and the water takes its place. Now pinch one end, to prevent any air from getting in, and pull it out of the water, taking care that the other end does not jump out. When the pinched end gets below the level of the vessel, release it, and the water will begin to run out. This plan need not be carried out in the tank, as the rockwork would be in the way. It can be started in another vessel of water, and afterwards removed to the tank. As long as the siphon is kept full of water while being moved from one vessel to another, it will run when placed in the second vessel. From this it may be seen that the flow may be started by sucking it when it is placed in a vessel of clean water, and afterwards moving it to the tank.

The water having been once manufactured, need never be thrown away, though it is sometimes less trouble to make fresh than to keep the old. If the whole tank gets into a state of putrefaction, and nearly every animal in it is defunct, still the water can be preserved. In this case the tank should be emptied, and the water filtered into a large earthenware vessel that is not in frequent use, and placed in an outhouse or some place where the smell given off will not be offensive. Here it must be left till the putrefaction has run its course, after which the water will resume its usual clearness. It should then be filtered back into the tank, putting a little charcoal powder into the flower-pot; and a few pieces of solid charcoal kept in the tank under rocks, &c., will be beneficial. When it is all in the tank, you can gradually add weeds and animals as at first, and the aquarium will be in working order once more.

If the fishes are observed at any time to go to the surface of the water to breathe, it will be known that the number of animals in the tank is disproportionate to the volume of water and the number of seaweeds. Under these circumstances it becomes necessary either to remove some of the stock, or to have recourse to artificial aëration. The former step is to be preferred, as it becomes tiresome after a time to be obliged to aërate the water every few hours; but if the owner is loth to move any of the creatures, he will have to find some means whereby the water may be able to renew the air taken from it by their respiration. It must be remembered that, besides the weeds growing in the depths of the sea, the water in nature receives a considerable amount of air by the action of the waves and wind. In the tank, though the seaweeds are there, the violent agitation of the water is absent, and therefore we have to compensate for this by artificial means. The flower-pot suspended over the tank, with a sponge in the hole, will do a great deal of good if used daily. The glass syringe forms a more effectual aërator; it must be pointed low down, so that the stream issuing from the nozzle will strike deep into the water, but must not be pointed so as to disturb objects on the bottom by the force of the jet.

An instrument similar to a syringe, for causing a continual stream of water, is sold by some dealers. A section of it is represented in Fig. 22. It consists of an indiarubber ball (A), to the bottom and top of which are fixed indiarubber tubes (D, E). Inside the ball are arranged valves (B, C), the former of which opens outwards, while the latter opens inwards. To work the instrument, all that is necessary is to squeeze the ball (A); when this is released, the air in entering through B shuts the valve, so that the only way in which air can enter is through C. Now, if the end of the tube E is placed in the water of the tank, the water will rise into the ball (A) by the force of suction. On squeezing the ball again, the valve C is closed by the water, and the valve B opens. The water, therefore, issues in a fine jet through D every time the ball (A) is squeezed. This instrument is obviously much less trouble to work than an ordinary syringe. With a little ingenuity, the aquarium-keeper might construct one for himself. The valves can be made of leather; the other parts could be procured from any chemist.

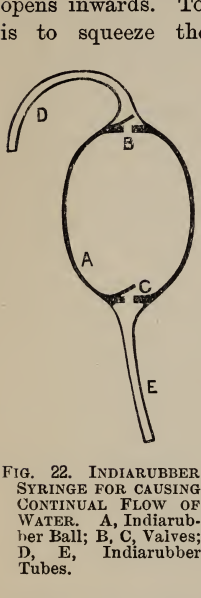

FIG. 22. INDIARUBBER SYRINGE FOR CAUSING CONTINUAL FLOW OF WATER. A, Indiarubber Ball; B, C, Valves; D, E, Indiarubber Tubes.

In the case of a slope-back tank being used, this instrument is of especial value. There is said to be a constant interchange going on between the water in the dark chamber and that of the tank in front. If the water of the tank becomes foul, however, it is necessary to make them change places more quickly. This is easily done by means of the indiarubber syringe. The lower tube being placed through one of the holes in the false bottom, the instrument is worked, when the clear water in the dark chamber is pumped out on to the surface of the dirty water in the tank, and the latter is thus forced to take its place in the dark chamber, where it will soon become clear again.

If the stones at the bottom of the tank become black, this is

a sign that some dead animal is resting on them, and it must therefore be taken out at once, and the stones replaced by clean ones. The rockwork can be cleaned, when necessary, with a small scrubbing-brush and a good supply of "elbow-grease." The weed growing on them sometimes gets into a very dirty condition, and in such a case it is best out of the tank. If the water gets into the putrid condition referred to previously, the rocks must be thoroughly scrubbed before replacing them in the aquarium. The latter had better be filled with dilute Condy's Fluid, and left to stand for some hours. In this way the horrible odour may be removed from the woodwork, and the tank rendered sweet and clean again.

It is as well not to handle the fish more than is absolutely necessary when transferring them to another vessel while the aquarium is being cleaned out; the deep net should be used, and the vessel in which they are placed should be covered over, especially if shallow, or they will jump out, being alarmed at this unwonted treatment.

The anemones are continually casting their skins, which will be seen enveloping them like a white cloud; these casts must be removed, or they will injure the water by their decay. A camel-hair brush is a good thing with which to free the anemones from this encumbrance. They quite appreciate the attention, and generally expand widely after the skin has been removed.

A convenient instrument for removing skins of anemones, undevoured meat, &c., is that known as the "dipping-tube," which consists of nothing more complicated than a piece of stout glass tube, about ¼in. in diameter, and of a length proportionate to the depth of the tank. This is manipulated by taking it in the right hand, and covering the end with the thumb or forefinger. The tube is now pushed downwards into the tank (keeping the end which is out of the water tightly closed) until the lower end is just above the offending object. The thumb is now taken away from the upper end, and the water rushing up into the tube carries with it the object to be removed. The thumb or finger is now again placed tightly over the upper end, and the tube withdrawn from the tank, by which means the water and the object are retained in the

tube. On removing the thumb these will fall out, and therefore care must be taken not to do so before the right time arrives. The tube can be bent by softening the glass in the flame of a spirit-lamp, gas-jet, or blowpipe; or two tubes can be kept, one straight, and the other bent nearly at right angles. The advantage of the bent tube is that the end can be readily inserted beneath the rockwork, into crevices, &c. At the same time, the bend makes the tube more brittle, and therefore it requires greater care in manipulating. Both ends should be partially fused in a flame, so as to round the edges, and prevent their cutting any soft object with which they may come in contact.

If the tank is kept in a moderately warm position (and, at all events, in summer), evaporation from the surface of the water will go on very quickly. It must be remembered that the *salts* do not evaporate, though the *water* does, and therefore the strength of the latter will be daily increased. To compensate for this, when the blue ball used to indicate the specific gravity (Fig. 7) is seen floating at the top, a little fresh water must be added, until it descends again. If a glass cover is made for the tank, the water will not evaporate quite so fast, but will still get perceptibly stronger after a few days.

Pieces of weed in the tank should be looked over occasionally, and if any yellow portions are found, indicating decay, they should be cut off with a pair of scissors.

If any of the tube-worms, especially *Serpula contortuplicata*, come out of their tubes, they must be closely watched, as the probability is that they will die in a day or two.

The water in the tank must never be allowed to become tepid by standing in the sun, or many of the live stock will perish. In connection with excess of light, it may be remarked that it is the height of cruelty to keep the tank in the sunlight, for the fishes, having no eyelids, and therefore not being able to close their eyes, are blinded by the glare of the sun. Ample rockwork, formed into caves, &c., must be given them, so that they can get into the dark when they wish to do so.

It may possibly happen that the anemones, &c., are placed in a pan while the aquarium is being cleaned out. If they are placed out of doors, and a shower of rain falls upon them, the

best way to get rid of the fresh water is simply to tilt the pan gently up until it runs off again. The fresh water, being lighter than the salt, does not mix with it, and therefore the lower layers will remain about the same strength as before.

The greatest possible care must be taken in cleaning out a "propagating-glass." A very short time ago I was cleaning out a particularly large one, which was placed on the ground, and accidentally got tilted over on one side. The instant it touched the ground it flew into a thousand fragments, and nothing was left but the stand. The fact of their being blown out of one piece of glass renders them excessively brittle, and it is hardly possible to crack one without its breaking to pieces. In some books I have read it is stated that a loud noise will break them, but this I scarcely credit: those I have had have stood a considerable amount of it without breaking.

In order to reduce risk of breakage to a minimum, the stand should not merely support the glass by the knob being fixed into the wood, but should be cut with a hollow, circular space, like a basin, into which the whole of the bottom will fit. Between the glass and the wood should be glued several thicknesses of felt or wadding, to prevent any sudden shock from jarring the glass. When cleaning it out, the greatest difficulty will be found to consist in getting rid of the ring of lime deposited at the level of the water as it evaporates. As the glass may be smashed by scrubbing too hard, the best plan is to take a small quantity of dilute hydrochloric acid (which can be obtained from any chemist), and rub it on with a piece of rag, when the lime will disappear like magic, and leave the glass beautifully clean. After cleaning, the tank must be thoroughly washed with several changes of water, to get rid of all traces of the acid.

I will now give some general warnings, and hope that by so doing I may keep my readers off the quicksands of aquarium-keeping, and render it less probable that they will regret having embarked on their undertaking.

Don't use deep pans or vessels to put animals in at the seaside. You will not wish to be always turning out your captures, and, the shallower the vessels, the more oxygen penetrates to the water, and therefore the clearer it keeps.

Don't make the grooves and holes in the slab of slate forming the bottom of the tank too shallow; the deeper they are, and the more cement is used, the less likely the tank will be to run out.

Don't use any cement that sets hard and brittle for fastening in the glass. Glass and wood both expand and contract with changes of temperature (the former very slightly, the latter a good deal), especially when water is first introduced, and if the cement is not elastic, it will be cracked in places, and the water will force its way through the cracks.

Don't attempt to make the pillars, &c., when constructing the tank, as light as possible; remember that the weight of sea water is enormous, one gallon weighing about 10lb., so that an aquarium which holds twenty gallons has to support a weight of 200lb., and if it is not built up strongly enough to withstand this force the water will make its way out somewhere. Aquaria used to be made absurdly fragile, but of late years an improvement has taken place.

Don't on any account let the carpenter use putty or red-lead cement in fitting in the glass; the former is utterly inefficient, the latter extremely objectionable in its after-behaviour.

Don't let him put the glass in by cementing it on to abutments. The grooves are absolutely essential if the aquarium is to be a success.

Don't put the tank in too light a situation; a coloured window behind it is good, scientifically speaking, but the colours do not improve the look of the tank when seen through it.

Don't be tempted into overstocking the tank. A small number of creatures in good health is far more interesting than a large number of weak and sickly specimens, some of which are daily found in a defunct state at the bottom of the tank.

Don't put specimens from a collection sent by rail straight into the tank; some are sure to be of a doubtful nature, and must be reserved for a few days before introducing them.

Don't put unsuitable specimens into the tank unless you have time to keep a sharp look-out on their movements; *e.g.*, the *Tealia crassicornis* is sure not to survive more than a few days.

Don't forgot to attend to the animals about five minutes per diem, to take out skins, &c. Stir up the water at intervals; the anemones will much appreciate the attention, and probably open widely.

Don't on any account put the sea water into the tank until it has been thoroughly cleaned by soaking for some weeks. Look out for prismatic scum on the surface of the water, and, if any appears, do not introduce the live stock.

Don't introduce into the tank to form rockwork stones which are coloured in places. This means that some chemical substance is present, and will probably exercise a deteriorating influence over the water.

Don't put in the rockwork without thoroughly washing and scrubbing it first. The same remark applies to sand and shingle.

Don't place any heavy ledges of rockwork against the glass sides of the tank; a jar may cause them to topple over, and crack it.

Don't forget to keep the outside of the tank clean by application of a cloth damped with *fresh* water; the salt water leaves smears on the glass when it dries.

Don't let any of the animals take a header up the siphon while running. The force of the water is very strong, and often impels the surrounding objects up it, even against their will. I have known a large eel get sucked bodily up the tube. The siphon can be stopped instantaneously by pinching it. It should be held in the hand while running, so as to be prepared for an emergency.

Don't mix up the water in the tank, but in cans, before it is introduced. It is better to make it too weak than too strong, but both extremes should be avoided, if possible. Two pairs of specific gravity bulbs should be kept, in case of accidents.

Don't put crabs, starfish, and other predaceous creatures, into a tank with other valuable specimens. They will not

look upon them from your point of view, and you will probably have reason to mourn some untimely losses.

Don't put red seaweeds, or those of a slimy nature, into the tank—at any rate for a first experiment. When you have been successful with the green species, a few red ones may be tried for a variety.

Don't give the anemones too much to eat, as if this is done they will not open properly. An anemone after having a large meal often refuses to open again for a week or two. Don't leave them too long, on the other hand, without feeding, as they get dissatisfied with their position if they do not have sufficient food, and release themselves from the rocks, hoping to find a more available situation.

Don't leave the water to itself until its volume is reduced about a third, as the creatures will thus run the risk of being pickled.

Don't, when diluting the water in the aquarium, pour the fresh water straight on to the top of an anemone. It takes some time for the two fluids to mix, and thus the anemone is practically enveloped in fresh water for a few moments, which may kill it outright. Pour the water on to the top of a rock, and allow it to mix gradually with the salt water.

Don't forget to remove all uneaten pieces of meat, skins of anemones, &c., as soon as discovered, and also all decaying pieces of seaweed. A trifling amount of care in this direction may save a great deal of trouble in making up more water.

Don't omit to empty the tank at once if a great number of animalcules make their appearance; if left till the next day, all the stock may be defunct.

Don't get disgusted, and sell the aquarium secondhand at once if you are not quite successful in your first attempts. There is no "royal road" to aquarium-keeping, any more than there is to playing the piano; but with care and attention you will win your way to success.

CHAPTER VII.

SUITABLE SEAWEEDS.

NUMBERS of variegated seaweeds are to be found on the shore tossed up by the waves, but there are very few that will live and thrive in the limited space assigned to them in the tank. On no account must the aquarium-keeper be tempted to introduce specimens at random, as there are some which die almost immediately, and thus corrupt the water; and there are others which give off a most obnoxious slime, and poison the animals. It will be much safer for the beginner to confine himself to two species, as the majority of those picked up on the shore are wholly unsuitable for the tank. The two species which are best adapted for the end in view—namely, the supply of oxygen to the animals—and which, moreover, live and grow without much difficulty in confinement, are the Sea-lettuce (*Ulva latissima*, Fig. 23) and the Sea-grass (*Enteromorpha compressa*, Fig. 24), both of which can be found in abundance on almost any shore, especially amongst rocks. The former may be known by its broad, flat, bright green leaves, which are

FIG. 23. SEA-LETTUCE (ULVA LATISSIMA).

puckered up at the edges into frills, and generally very much lacerated by the tide washing them against the rocks. The latter is exactly the reverse of this, its leaves being very long, narrow, and tapering; it is also of a green colour, but slightly darker in tint.

It may here be remarked, that all specimens of seaweed intended for the aquarium must be growing on rocks or small stones, which can be placed in the tank as they are. If the weed is growing on a large rock, the piece on which it is growing must be chipped off by the skilful use of the hammer and chisel. Loose pieces will live for a short time, and do a certain amount of good in oxygenating the water, but they soon turn yellow, and have to be removed from the tank. If a piece is growing on a tolerably large piece of stone, which can be placed bodily in the tank, it will continue to grow for a considerable time, and pour forth an abundance of oxygen. On a dull day the Ulva will generally lie down very low at the bottom of the tank, but on a bright day it will stand almost erect. If the leaves are examined, the cause of this will be seen to be the number of small bubbles of gas which are adhering to their under surface, and so buoy them up in the water. All these bubbles consist of pure oxygen gas, and it is for this reason that the Ulva is so especially valuable to keepers of aquaria. The scientific-minded reader may easily prove this for himself by filling a small bottle, or preferably a chemical test-tube, with the water of the tank, and inverting it thus completely full of water just over the weed when covered with bubbles on a bright day; if the weed is now gently moved with a stick, the bubbles will be dislodged, and rise upwards into the tube, dispelling the water, and filling the tube with gas. This gas can now be proved to be oxygen by intro-

FIG. 24. SEA-GRASS (ENTEROMORPHA COMPRESSA).

ducing into it a match or splinter of wood which has been allowed to burn for a few moments and then blown out, leaving the end glowing. This glowing end will be instantly rekindled, which is a characteristic property of oxygen gas, and thus prove the gas given off by the weed to consist of pure oxygen. The leaves of the Enteromorpha will also be seen to be covered with bubbles on a fine day, and that plant is therefore almost as valuable an addition to the tank as the Ulva.

It is better for the beginner to be content with five or six specimens of these weeds, which will be enough for a large tank, if they are of a moderate size, and the tank is shallow, as described in Chapter II., and a large surface of water is therefore exposed to the air. There are, however, numerous other specimens of both green and red weeds which may be safely introduced into the tank when it is in proper working order, provided that a sharp look-out is kept to see if they show signs of decaying, and so rendering the water impure. There is a weed which very much resembles the Sea-lettuce in form, which is called the Purple Laver (*Porphyra laciniata*). The leaves of this species are of a dark purple colour, instead of green. It is much used as a culinary vegetable by some people, and especially so by the inhabitants of the "Emerald Isle," where it is a favourite article of consumption. It has a special name when thus cooked, being known by the name of "sloke." There is another member of this group—*Porphyra vulgaris* (Fig. 25)—which can be kept in an aquarium, and will grow to a great size therein.

FIG. 25. PURPLE LAVER (PORPHYRA VULGARIS).

Another weed, sometimes used as a vegetable, and considered a great delicacy by some people, is the Dillosk (*Iridea edulis*), sometimes called the Dulse. It is a beautiful plant when in health, as its colour is a very dark ruby. It is called by its scientific name of *Iridea* from the iridescent colours which

play over the surface of the leaves when under water, somewhat in the same manner as the colours on the surface of mother-of-pearl.

The Carrageen Moss (*Chondrus crispus*, Fig. 26) is a very well-known and plentiful species on the shore. It is frequently eaten when boiled till it forms a jelly. If pounded with a pestle and mortar, with hot water, it dissolves like glue, and

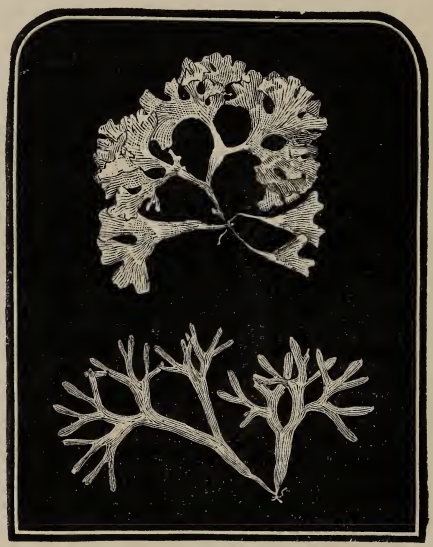

FIG. 26. CARRAGEEN MOSS (CHONDRUS CRISPUS).

forms a gelatinous solution, which can be used for sticking papers and light articles together. A large tuft of this weed has a very handsome appearance, but takes up too much space in an aquarium. This species is also occasionally iridescent.

There is another plant that grows in large, feathery tufts, which may be found without much trouble on the part of the hunter, as it is comparatively common on most shores. This

is the *Cladophora arcta* (Fig. 27), which does not seem to have earned a popular name. Its feathers are of a dark green colour,

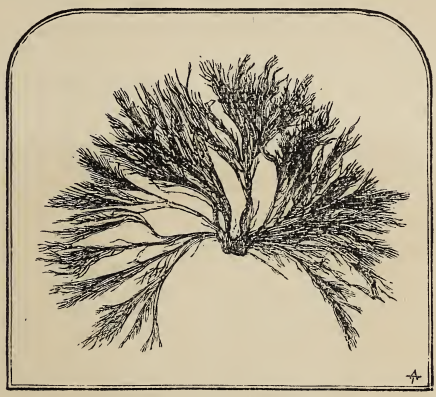

FIG. 27. CLADOPHORA ARCTA.

and, being very bushy, its small branches afford a refuge to heaps of small animals, such as crustacea, &c., a number of

FIG. 28. BRYOPSIS PLUMOSA.

which will be found amongst its leaves when removed from the water. It should, therefore, undergo a careful examination before being placed in the tank, in order to secure any

specimens that may be worth inserting, and also that, if any dead animals are found, they may be removed, so as to run no risk of contaminating the water. This weed lives happily in the tank, its feathery tufts waving gracefully with any motion of the water.

A pretty little species is the *Bryopsis plumosa* (Fig. 28), which

FIG. 29. COMMON CORALLINE (CORALLINA OFFICINALIS).

is also a green, feathery plant; but in this case the feathers are set on long, slender stalks, instead of extending down to the roots, which gives it a very elegant appearance. This plant, being an annual, is only to be found in certain seasons of the year, and for the same reason it is hardly suitable for

the tank, though a few specimens may be put into it for a month or two.

The Corallines form a branch of algæ totally distinct from the others. Their remarkable feature is the chalky skeleton, which remains after the vegetable portion of the plant has decayed. Specimens of these will live well in the tank, and will not do much harm if they decay, as they are principally composed of chalk. The chief representative of the family is the common Coralline (*Corallina officinalis*, Fig. 29), a tolerably

Fig. 30. Delesseria (Mangeria) sanguinea.

abundant species; it is a bushy plant, with stiff, jointed branches, of a light pinkish hue. When dead, the chalky skeleton is plainly discernible. The aquarium-keeper can try the experiment of the "coralline light" with this plant. If a shoot is taken which has been dried, and the tips of the branches are held to the flame of a candle, at the very edge, it will be found that some of the shoots will become red hot, and then white hot, and glow with a very intense and dazzling light. It is necessary that the piece which produces the effect should be held just at the border of the flame, for, if it is pulled

out, or pushed in, the light will disappear, again becoming visible when brought to the border of the flame. The same shoot will produce the effect an unlimited number of times. It is probably due to the presence of lime in the chalky skeleton, as other calcareous bodies behave in the same way.

A showier and more brilliant weed is *Delesseria* (*Mangeria*) *sanguinea* (Fig. 30), with its gorgeous crimson fronds, which present a magnificent appearance when the light is shining through them from a window behind the tank. This plant will not stand removal from the water for any length of time, and must therefore be placed in a can of water when found, and not in a basket in company with other seaweeds.

Only one of the brown weeds will be eligible for admission into the aquarium, and that will not live therein for a long period. This is *Padina pavonia* (Fig. 31), which is such a remarkable-looking weed, with its broad, fan-shaped leaves, and the dark bands crossing them at regular intervals, that some reader may feel disposed to insert it in his tank for a few weeks.

FIG. 31. PADINA PAVONIA.

There is much difference of opinion respecting the suitability of the different seaweeds for the aquarium. The fact seems to be, that if the tank is to be kept in a very light situation, and with a large proportion of animals to the weeds, the green weeds are by far the best; but the late Mr. Gosse was of opinion that, if the tank is kept in a dark place, the red varieties are more likely to thrive in it, being accustomed to deep water, where the light is feebler. Of these he considered *Iridea edulis* the best, followed by *Delesseria sanguinea*, both of which he thought very serviceable in giving

off large quantities of oxygen. My own experience goes to prove that the green varieties bear the confinement of the tank better than the red, whose span of life is usually brief. If, however, the reader can get the red varieties to thrive, he may congratulate himself, as they give a much more striking appearance to the tank than their congeners of the ordinary green hue.

CHAPTER VIII.

SEA-ANEMONES.

IF the intending aquarium-keeper can manage to curb his natural impatience to view the result of his labours, it is much better to leave the seaweeds in the tank for some days—say a week—before introducing the animals, as by that means the water becomes fully charged with oxygen, and also with the spores of the seaweeds, which will settle on the rockwork, and will, when growing, form a velvety-green coating, which is highly beneficial to the inmates of the aquarium. If at any time bubbles are observed rising from the surface of the rockwork, this is a sign that the water is in a fit state for the reception of the live stock.

The beginner in aquarium-keeping will have to exercise a considerable amount of self-control in stocking the tank. As a general rule, the first thing he does is to put nearly everything that he finds on the shore, that takes his fancy, into the aquarium. The consequence is, that many of the creatures, being wholly unsuited for living in captivity, creep into holes in the rockwork, and die forthwith. This renders the water unfit for the hardier animals, who succumb in their turn, and the whole contents of the tank become a mass of putrefaction, and give off an odour which words are powerless to describe, so that there is nothing to be done but to turn the whole thing out as fast as possible, and start afresh in a more methodical manner.

The most beautiful inhabitants of any aquarium are, undoubtedly, sea-anemones. Even in the Brighton Aquarium itself, where all sorts of wonderful creatures are to be found, the tank allotted to these animals is by far the most attractive to the majority of visitors. Being very sedentary in their habits, they are well suited for a parlour aquarium. I will therefore describe some which will live happily therein.

On nearly all our shores not entirely destitute of rocks are to be found at low water, by carefully searching amongst the tangled masses of seaweeds, little lumps of a jelly-like substance, some green, and some red, adhering tightly to the rock, and by no means prepossessing in their outward appearance. These are scientifically named *Actinia mesembryanthemum* (*Actinia equina*, Linnæus), represented at Fig. 32, and commonly known as the Beadlet Anemone, from a peculiarity which is entirely their own. If removed from the rock without the base being injured, either by a judicious use of the finger-nail, or, better still, by a paper-knife, and put into a basin of sea water overnight, in the morning they will be found to have blossomed out into "flowers" of the most brilliant tints. When thus fully expanded, by looking underneath the tentacles round the edge of the disk a ring of bright blue beads (or spherules) may be seen, and it is from these that the popular name is derived. By some naturalists these beads are held to be a primitive form of eye. *A. mesembryanthemum* is the commonest and hardiest of all the sea-anemones, and will endure captivity even under the most trying circumstances. There are several

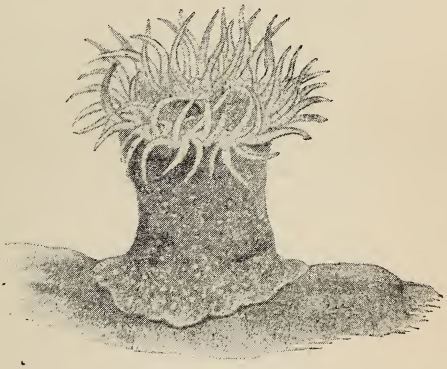

FIG. 32. BEADLET ANEMONE (ACTINIA MESEMBRYANTHEMUM).

well-marked varieties, differing principally in colour, the variety known as the Strawberry, the ground-colour of which is dark red, speckled with yellow, being the largest.

By far the most beautiful of all the tribe is the Plumose Sea-anemone (*Actinoloba dianthus*, Fig. 33), which is a most magnificent creature when fully expanded. It usually takes the shape of a tall column (5in. to 6in. high, and 2in. to 3in. broad), with a disk at the top, surmounted by hundreds of short tentacles, the outer rim of the disk being puckered into folds, from which the outer rows of tentacles droop gracefully over the edge. The specific name, *dianthus* (Latin for carnation) was given to it from its resemblance to the carnation, or clove-pink. These creatures are to be found of various colours—some sulphur-colour, some pink, some with brown column and grey disk and tentacles, and some pure white. Mr. Gosse classifies the varieties as follows: *brunnea*, those of the various shades of brown; *rubida*, those of a reddish hue; *flava*, those of a yellow tint; and *sindonea*, pure white. The pure white is by far the most striking variety; it must be seen fully expanded to be appreciated at its proper worth. As Plumose Anemones possess almost unlimited powers of expansion and contraction, they hardly ever remain in the same form for many hours at a time, and the extraordinary shapes into which they mould themselves when anything happens to annoy them—such as a fish swimming across the expanded disk—are most diverting to the observer. They are, unfortunately, only to

FIG. 33. PLUMOSE ANEMONE (ACTINOLOBA DIANTHUS).

be found in deep water, but can be procured from a dealer in marine specimens; or, if the aquarium-keeper is skilful in the use of the dredge, they can be obtained in that way. *A. dianthus* is the only British species; it is very generally distributed. They were especially common in former days at Falmouth, Weymouth, and Tenby, and are still to be found at these places in tolerable abundance. I have frequently obtained specimens of this anemone, and many other marine creatures, from advertisers in *The Bazaar*.

It was formerly believed (by Dr. Johnston amongst others) that the Plumose Anemone was attached to the rock, and could neither move from it of its own accord, nor be moved, without fatal results. This idea was erroneous, as the late Mr. Gosse discovered, and any of my readers can test for themselves, as it will be found, if specimens are kept in the tank, that they will move about freely from place to place in the same manner as any other species. It is certainly true that a smaller amount of injury to the base proves fatal to this anemone than to many of the hardier kinds, and for this reason specimens should always be procured by chipping off the fragment of rock to which they are adhering, and not by tearing them off by force. It is, however, quite possible to get them off the rock without injury to the base, in which case they recover after a few hours.

If the Plumose Anemone is roughly handled, it will shoot out an immense multitude of minute fibres, until the water around it is thick with them, and the anemone itself is lost amid a tangled mass of what precisely resembles white cotton. These fibres, however, are very formidable weapons to the smaller inhabitants of the tank. It was for some time doubted whether any really fatal wound could be inflicted by these fibres; but Mr. Gosse's experiments and investigations seem to prove that fishes on being struck by them are usually killed outright. The fibres are contained in small vesicles in the epidermis of the anemone, and are retracted again when desired. The Plumose Anemone also has a habit of evolving a quantity of mucus when alarmed, or in a bad temper, which renders the surrounding water muddy.

When this happens, the anemone will generally make itself "as flat as a pancake," and will not resume its columnar form for some hours, when it gradually retracts the "acontia," imbibes a large quantity of fluid, and once more assumes its usual shape.

The Snake-locked Anemone (*Cylista viduata*, Fig. 34) is an exceedingly elegant inhabitant of an aquarium. When extended, it has the appearance of a long column branching out from the rock to which it has attached itself; the disk is small (about 1½in. in diameter), with some 200 long, slender tentacles, arranged in five rows, which wave about in seemingly inextricable confusion with every motion of the water. This anemone, like the Plumose, is very capricious as to its shape. When offended by rough handling, or by a fish passing over its expanded disk, &c., it will shrink up until its whole body has completely collapsed, and present the appearance of a minute button of a flat shape sticking to the rock—not in the least resembling the stout column with mass of waving tentacles just described.

FIG. 34. SNAKE-LOCKED ANEMONE (CYLISTA VIDUATA).

The name *Sagartia*, given to these species and others by Mr. Gosse, indicates the weapons with which they destroy their victims, being derived from the Sagartians, a race described by Herodotus.

The Opelet Anemone (*Anthea cereus*, Fig. 35) is a species readily kept in an aquarium, and in shape has been compared to a dice-box. Its most noticeable feature is its long, non-retractile tentacles, which number about 180, and are arranged in four rows. According to some naturalists, this species is capable of causing unpleasant sensations if touched by the hand, and especially if the creature be unhealthy, or suffering from

long confinement. The green variety (*smaragdina*) is very handsome, the column being brown, with light green tentacles, each of which is tipped with bright red.

The largest of our British anemones is *Tealia crassicornis* (Fig. 36), to which Mr. Gosse, in his "History of the British Sea-anemones and Corals," has given the name of Dahlia Wartlet. It is a very appropriate title, as the colour of the spread tentacles, which are very short, and extremely thick in proportion to their length, closely resembles the flower of the Dahlia; and the chief defence of this species consists

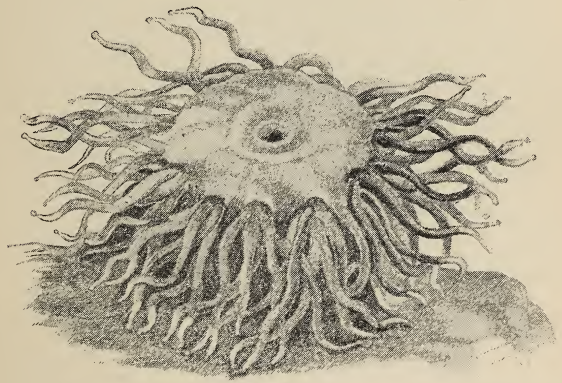

Fig. 35. Opelet Anemone (Anthea cereus).

in the little projecting warts with which its body is covered: to these are attached small stones, &c., which completely conceal it from view when closed. Though the Plumose is the most beautiful species in form and elegant appearance, the Dahlia Wartlet is by no means to be despised, as its colours are vivid in the extreme. It may be found of all shades, from white to crimson and green, and the tentacles are nearly always coloured, in bands of crimson and white. A large specimen will measure over 5in. across the disk, and is a truly gorgeous object. The usual size is: Height, 2in.;

diameter, 3in. This species is exceedingly voracious, and woe betide any little fish which, in swimming across the tank, comes in contact with its tentacles; it has even been known to swallow two or three moderate-sized specimens of the Green Shore-crab. If one of these Dahlia Wartlets is placed at the bottom of the collecting-can, it is not unlikely to devour half the other captives by the time it arrives at its destination.

Unless the aquarium-keeper wishes to try an experiment in keeping this creature for a few days, to observe its habits

Fig. 36. Dahlia Wartlet Anemone (Tealia crassicornis).

in confinement, he is not advised to introduce it into his tank. It is far too big for an ordinary tank, and requires a very large volume of pure water for respiration. If it does not get this, or if the base is but slightly injured in removing it from the rock, it speedily dies. Better leave it in its native place than run the risk of killing it and the other inhabitants of the tank. If the reader can succeed in keeping a specimen alive, he is to be congratulated, as it is one of the most gorgeous objects that can be added to the tank. Pennington, in "British Zoophytes" (p. 171), says: "This species is one which may be kept with ease in an aquarium,

and there forms an object of great interest"; but he must have been exceptionally fortunate in his experiments, as the majority of aquarium-keepers have found otherwise, among others Mr. Gosse and the Rev. J. G. Wood, who agree that Dahlia Wartlets will only live in a very large bulk of water. My own experience goes to prove that they die in a few days.

There is a lovely anemone, which frequents rocky places, called the Daisy (*Heliactis bellis—Sagartia bellis*, Gosse), shown at Fig. 37. It is a very good species for the aquarium, as it is tolerably hardy; but it is an extremely difficult animal to have any dealings with, as it invariably fastens its base to the bottom of some hole in the rock, and expands its flower-like disk at the opening. As soon as this disk is touched, the anemone suddenly closes, and rapidly withdraws itself into the hole, and this being far too small for the fingers to penetrate, the solid rock surrounding it forms a most effective barrier to the further approach of the foe. In this case an onslaught must be made on the stony fortress with hammer and chisel, and in process of time, if the collector is skilful in their use, he may hope to see *Heliactis bellis* gracing the stones of his tank, where it should be provided with a stone with a hole in it similar to the hole in the rock from which it was taken, to the bottom of which, if it was uninjured by the blows of the hammer, it will soon affix itself, and expand its disk at the surface as it was doing when first discovered.

FIG. 37. DAISY ANEMONE (HELIACTIS BELLIS).

The shape of the Daisy Anemone is unique: in the other species of sea-anemone the disk is merely the termination to and is hardly any larger round than, the column; with the Daisy, however, the case is different. The column of this species is small compared with the disk, the latter being usually about

four times as much in diameter as the body, and expanding abruptly at the top of it. This formation is no doubt given to the anemone to enable it to hide in the holes of the rocks, and to expand its disk at the opening of the hole.

This species does not vary much as to colour. In most specimens the column is white at the base, flesh-coloured as the disk is approached, then lilac, and finally, at the disk, of a purplish colour. The top of the disk is usually of a brown colour, sometimes speckled with grey on the inside, and merging into white on the outer row of tentacles. The tentacles are, more usually, dark brown at their bases, and lighter brown the rest of their length; they are spotted with white, and those of the inner row have one or two rings of white near the base, and a spot of white, divided by a brown line, longitudinally, on the disk, at the point of junction. The whole colouring gives an exceedingly pretty effect when the disk is expanded, and has gained for the anemone its popular name from a fancied resemblance to the flower of the daisy.

FIG. 38. GEM PIMPLET ANEMONE (BUNODES GEMMACEUS).

Another species sometimes discovered unexpectedly by the enthusiast is the Gemmaceous Anemone, familiarly known as the Gem Pimplet (*Bunodes Gemmaceus—Actinia Gemmacea*, Gosse), illustrated at Fig. 38. This has forty-eight tentacles, those of the outermost circle being smallest, and those of the innermost largest. The colour is generally transparent olive, marked across the inner side with bands of white, which reach about half way round the tentacle. These bands are

the characteristic feature of the animal, which is easily kept in aquaria, and is very prolific.

Similar in its habits to the Daisy, but not resembling it in colour, is *Heliactis venusta* (*Sagartia venusta*, Gosse), or Orange-disked Anemone. This lives in a little crevice or cranny in the rock, or takes possession of a hole formerly occupied by a boring mollusc. It is sometimes found in a pool the bottom of which is covered with soft mud, the anemone being fixed to the rock beneath the pool, and elongating its column so that the disk appears at the surface of the mud. In colour the column is a warm brown, sometimes deep buff or orange brown. The disk is of a vivid orange, from which the animal derives its popular name; it has no markings on its surface. The tentacles are perfectly white, and the mouth of a rather paler orange than the rest of the disk. The upper portion of the column is covered with suckers. The colour of this species being very brilliant, a company of a dozen or so is an exceedingly gorgeous spectacle to behold. Unfortunately, they are not particularly common, but when found they are tolerably hardy, and can easily be kept in the aquarium. It is mostly found at or in the neighbourhood of Tenby.

There is another species, of about the same size as the last, in which not only the tentacles, but also the disk, are a pure white colour, from which fact it has taken its popular name of the Snowy Anemone, and its scientific one of *Sagartia nivea*. Dr. Andres regards this as a variety (*immaculata*) of the foregoing species. Its column is of a yellowish white, and both disk and tentacles are of an opaque white colour, without markings. It may be found in pools, &c., when the tide has receded. This anemone evolves acontia very freely.

The Cave-dwelling Anemone (*Cylista undata—Sagartia Troglodytes*, Gosse) is so named from its solitary and hermit-like habits, as it always dwells by itself in a cave or hole in the rocks. Sometimes it detaches itself from the rocks, leaves its cave, and allows the waves to carry it wherever they choose. It occasionally passes several months in the open sea, anchoring itself by means of its tentacles to any object that may take its fancy. When expanded, the column of this anemone is tall

and thin. It has a large number of tentacles—sometimes more than 200 on one individual. In colour, the column is olive-green, marked with pale, longitudinal stripes. The disk is varied with black, white, and grey, in a pattern very much resembling a snipe's feather. At the foot of each tentacle is a mark precisely resembling the Roman capital letter B, more or less distinctly seen, which characterises every variety of this species. The colour of the tentacles is pellucid grey, crossed with three or four bands of white.

FIG. 39. PARASITIC ANEMONE (ADAMSIA RONDELETII).

One of the largest of our British sea-anemones is the Parasitic Anemone (*Adamsia Rondeletii* — *Sagartia parasitica*, Gosse). See Fig. 39. It often attains a height of 4in., and a diameter of 2in. or 2½in. Its column is of a dirty white colour, with bands of dark brown or purplish brown running down it. The disk is a little wider than the diameter of the body, and the tentacles hang down over its edge. The mouth in the centre is raised above the level of the surrounding disk. There are seven rows of tentacles, generally of a whitish colour, but they may be yellow or purplish. Each tentacle is marked with dashes of a purple colour, running down the opposite sides till they meet

at the tip. The colour of the disk is also pellucid yellowish white. This anemone possesses stinging threads with which to slay its victims; the threads are more than usually plentiful, and are generally fatal to any fish, &c., at which the anemone may think fit to aim. They are easily retracted again within the cells of the epidermis. The aquarium-keeper will find this a hardy inhabitant of the tank, but let him not handle it rashly, as the peculiar odour which it imparts to the hands is disgusting in the extreme, and no amount of soap and water, or even scrubbing, will remove it.

A. Rondeletii is not always met with on shells; it is sometimes, though rarely, found on stones, rocks, &c. It almost invariably selects either the shell of the whelk (*Buccinum undatum*) as its resting-place, or that of the common Soldier Crab (*Pagurus Bernhardus*). There is, however, another Parasitic Anemone which always chooses to affix itself to the Purple Soldier (*Pagurus Prideauxii*); this is the Cloak Anemone (*Adamsia palliata*). There is a most remarkable affinity between these two animals, the anemone hardly ever being found without a crab, or the crab without the anemone. It seems as if the anemone was born to keep the crab in existence, and the crab to keep the anemone. If either of this strangely-assorted pair gets killed, the other will die in a few days. The crab is fully alive to the importance of the anemone's companionship for its existence, and acts accordingly. It had often been wondered how the crab took the anemone with it on changing its shell for a larger one. This was investigated by Mr. Gosse, who kept both creatures for some time in an aquarium, and found that when the crab had occasion to change its shell, it deliberately took the anemone off the old shell with its claws—the anemone relinquishing its hold for the purpose—and placed it on the new one, where the anemone fastened itself securely in the course of an hour or two. The Adamsia adheres round the mouth of the shell, curling round the crab in the manner of a woollen comforter, the crab protruding freely from the opening in the centre. The popular name of this anemone is given to it from the fact that it surrounds the shell like a cloak,

and does not stand erect, as the other anemones do. Its column, which is so short as to be hardly noticeable, is of a sienna-brown colour, gradually merging into white. The tentacles are white. The body of the anemone is covered with purple or reddish-brown spots. When expanded, the anemone's disk is beneath the crab's body, and anything not devoured by the crab is taken possession of by the anemone.

If any of my readers live in or near Weymouth, they may perhaps fall in with a specimen of the Red-speckled Pimplet (*Bunodes Ballii*), which was formerly called the Weymouth Anemone, from the fact that it was first found there, on the ledges of rock, at low water. A variety of the species also exists in the deep water of the Bay, and can be obtained by dredging. It is also found at other places on the coast. The Red-speckled Pimplet thrives in an aquarium, where it carries out its natural tendency to burrow under a stone, and so conceal itself from view. The column of this anemone is broad and flat, hardly rising to a pillar; its colour is pale yellow, covered with crimson excrescences. The disk is pellucid grey, covered with specks of white of different sizes and shapes. The tentacles are pellucid yellow, and some are generally striped with pink.

The searcher after marine objects sometimes unexpectedly lights on a specimen of the Scarlet-fringed Anemone (*Heliactis miniata—Sagartia miniata*, Gosse). The column of this species is covered with large suckers, and is very thick, not being so high as it is broad. The disk is yellowish—sometimes greenish—grey. The tentacles are pellucid and light brown in colour, with bars of black and white across them. Those of the outer rim are pellucid, with a core of brilliant crimson, resembling the papillæ of an Eolis. It is from these scarlet tentacles that the anemone has received its popular and specific names. The mouth is of an orange-red colour. This anemone is sometimes found on oyster-shells before they have been cleaned for the market. It occasionally reaches a size of 2in. in diameter. It is found at Torquay, and other places on the Devonshire coast.

A very striking species of anemone is the Trumplet (*Aiptasia Couchii*, Fig. 40), which is rather similar in shape and habits

to the Snake-locked Anemone and the Opelet. The column of this anemone is extremely attenuated, and enlarges at the top to a trumpet shape. The disk is thin and membranous, the tentacles being arranged in four rows; they are very long, and curl about gracefully when the creature is expanded. Its colour is orange-buff, with faint lines, the ground-colour becoming bluish black at the cup. The disk is dark grey, and the tentacles sepia-brown, merging into white at the tip of each. The height of the anemone, when expanded, is about 4in., and it is from ⅛in. to ¼in. in diameter. The expanded flower is about 3in. in diameter. This species is found in Guernsey, and at Falmouth and other places. If irritated, it emits *acontia* copiously from the mouth, and if wounded, from the wounds. It almost always remains expanded, from which fact its name of *Aiptasia* (from the Greek ἀεὶ, "always," and πετάω, "to expand") was given to it by Mr. Gosse. It is very hardy, as may be imagined from the fact that Mr. Holdsworth gives an account of one which was swallowed by a Daisy Anemone, and, having been extracted from the interior of the latter, speedily recovered.

FIG. 40. TRUMPLET ANEMONE (AIPTASIA COUCHII).

As a general rule, sea-anemones prefer a bright day to a dull one, and a larger percentage of those in the tank will be found open on a sunny day than on a gloomy one. There are, however, several exceptions to this rule. *Actinoloba dianthus* vastly

prefers the dark; and if anyone wishes to see it expanded to the utmost extent, let him pay a visit to the tank with a candle in the late hours of the night. It can often be made to expand by covering the tank with a thick cloth, so as to exclude the daylight.

Anemones will breed very readily in captivity, and one frequently finds a little nook, which has been overlooked for some time, crowded with quite a colony of youngsters. They are, as the observer will soon discover, expelled from the mouth of the parent, and, falling upon the stones round her (or him, or it, for there is no difference in the sex of these creatures), set up life at once on their own account, fixing themselves firmly to the rock, and expanding their disks and tentacles in the most precocious way. They generally get lost among the green if care is not taken; but perhaps an "unusually fine child" may survive for some months.

This is the usual method of reproduction in the anemones, but some species (such as the Plumose) have another method as well, known as the "method of sub-division." Sometimes a large specimen, after being fixed to a stone, or the side of the tank, for some time, will move off to another place. While doing so, it may happen that it will leave behind it small pieces of its own substance adhering to the glass or stone, as if these pieces were so strongly fixed on that it was necessary to leave them behind. If the pieces are carefully watched, they will be found to gradually develop a disk and tentacles, and in a few weeks will become distinct anemones (with but few tentacles at first, the number increasing with their growth), and begin life on their own account. In nature, one large specimen is generally found surrounded by a colony of small ones, all of which were probably produced in this way.

CHAPTER IX.

CORALS.

THERE is another animal which very closely resembles the sea-anemone when expanded, though the similarity disappears when it is closed. Let the reader imagine the bottom half of the column of an anemone turned into stone so as to become to all intents and purposes part of the rock, and the upper part of the column, together with the disk and tentacles, made capable of being withdrawn within the stony part of the column, or extended far above it, at the will of the animal, and he will have a very good idea of the common Madrepore (*Caryophyllia Smithii*, Fig. 41). This creature will live for a considerable time in an aquarium with very little or no trouble on the part of the owner. Each tentacle in the madrepore is terminated by a globular head, and the substance of the creature being extremely thin and transparent, it forms a lovely object when fully expanded.

Another member of this family is the Scarlet and Gold Madrepore (*Balanophyllia Regia*, Fig. 42). This is a smaller species than the former, but more brightly coloured. The disk protrudes above the plates of the stony skeleton in the form of a cone. The tentacles are about fifty in number, large, of a conical shape, and obtusely pointed; they have no terminal knobs, like those of *Caryophyllia Smithii*. The column of this madrepore varies in colour according to age, being orange in young specimens, and vivid scarlet in older ones; the tentacles

are gamboge-yellow. When fully expanded, the creature may be ⅓in. in diameter and ½in. in height. It will thus be seen that it is a very small being; but, for all that, its vivid colouring renders it a very conspicuous object in the tank. It is to be found chiefly on the north coast of Devonshire, on rocks, at extreme low tide. The disk of this species is hardly ever wholly retracted within the stony portion, and it does not imbibe so much water as the Caryophyllia, therefore its tentacles do not become so completely transparent.

FIG. 41. COMMON MADREPORE (CARYOPHYLLIA SMITHII), Expanded and much Magnified.

FIG. 42 SCARLET AND GOLD MADREPORE (BALANOPHYLLIA REGIA), not Expanded.

These madrepores are representatives of the great family of Corals, which is a branch of the larger body of *Cœlenterata*, the latter including the anemones, corals, zoophytes, jelly-fishes, and similar animals, which are like anemones in the general details of their structure. The true corals, to whom is due the formation of the vast structures known as coral islands, are the subjects of much misrepresentation and a good deal of ignorance. Many people imagine that these creatures are "insects," and build up

their homes of permanent material in the same way that bees make their more destructible combs. This is, of course, not the case: the coral has no more hand in building the coral island than the madrepore has in building his stony skeleton. The lime is deposited on the plates as the coral grows, in a manner analogous to the growth of the "box" of the Sea Urchin, which will be described in a subsequent chapter. The branching corals are made up of thousands of simple cups, called "corallites," each similar to the simple coral, of which *Caryophyllia Smithii* and *Balanophyllia Regia* are examples. Every corallite on the mass (or "corallum," as it is called) has its inhabiting polype, which projects a ring of tentacles at the surface similar to that of the madrepore. The corallum increases by a process called "budding," due to the steady deposition of lime caused by the growth of the animal; this growth is necessary for the formation of the corallum, just as it is necessary for the body of a higher animal to be in a state of growth in order that phosphate of lime may be deposited on the bones — the phosphate of lime of the animal being derived from the food eaten, and the carbonate of lime of the coral from the chemical substances contained in the surrounding water.

FIG. 43. TUFT CORAL (LOPHOHELIA PROLIFERA).

We have only one representative of the race of Branching Corals on the British coasts: this is *Lophohelia prolifera* (Fig. 43), sometimes called the Tuft Coral. It has a tree-like form, consisting of short branches rising from a slender base; the base is permanently attached to the rock, from the body of which it can only be separated by breaking off the piece to which it is fixed by the help of a cold chisel. A magnificent specimen of the Tuft Coral, weighing 6lb., is preserved in the museum of King's College, Aberdeen.

The Branching Corals are the inhabitants of deep water: their corallum is extremely brittle, and would be liable to be broken

off by the force of the waves nearer the surface. The Compound, or Reef-building Corals, on the other hand, dwell near the surface, and it is therefore necessary that they should be possessed of extreme lightness and strength, and that their growth should be rapid. The lightness and strength required are obtained by a wonderful organism, which has furnished a model to engineers in building structures exposed to similar circumstances. The original cup grows directly upwards, and after it has been growing for some time, a deposition of lime takes place within the animal, which forms a new "flooring," so to speak, above the previously-occupied cell. The polype thereupon vacates its former premises, and takes up its abode in the higher chamber, leaving the former ones untenanted. In an individual coral (a "corallite") of about 1½in. in height may be found, by examining it carefully, several dozens of these floors untenanted by a polype. The consequence of this arrangement is, that in a very large mass of coral only a very small fraction of its length is tenanted by the soft portions, all the rest being separated into partitions, forming a framework of carbonate of lime built up of uprights and crosspieces, and very strong and light, owing to its calcareous substance and slender structure. As the coral grows its crossfloors, it at the same time produces other corallites similar to itself, which grow up along with the parent stem. As all these outside corallites grow up, more crosspieces are formed outside, so that eventually the Reef-building Coral has a number of tubes connected together by crosspieces, each tube having the cellular structure within it.

FIG. 44. MADREPORA ABRATANOIDES.

The coral usually seen in collections of shells, &c., is an inhabitant of the Pacific Ocean. One species—*Madrepora abratanoides*—is represented at Fig. 44. Corals of various species grow

and flourish all round the coast of South Italy, and many species which have been brought from foreign climates may be seen living in some of our large public aquaria.

In an aquarium, a Branching Coral, if watched, will be seen to protrude its polypes and expand the tentacles in search of food. If one is touched lightly while expanded, a sticky sensation is felt, similar to that caused by the tentacles of an anemone. The minute polypes evidently feed on microscopic organisms present in the water, which are not discernible to the naked eye. Occasionally, however, a larger victim may be caught, in which case it will be seen that all the tentacles inclose it simultaneously, and drag it towards the expanded mouth, in which it is presently engulfed. The acontia are present in the coral-polype, just as they are in the anemone, and are just as fatal to their smaller victims. Under the microscope, the cells containing these acontia (which are called "nematocysts," or thread-cells) are plainly discernible.

CHAPTER X.

FISHES.

A LARGE number of fishes are, of course, unsuited for the aquarium on account of their size and the space required for their maintenance, but there are several small kinds which may be kept with ease. The best of these are two little fishes known as the Blenny and the Goby, which may be found in hundreds in many a rock-pool, and only require to be removed with the net. It is not easy to find even a moderately large specimen; but the small ones speedily die in captivity, or fall victims to anemones, so that it is best to select the largest that can be found. The common Smooth Blenny is illustrated in Fig. 45.

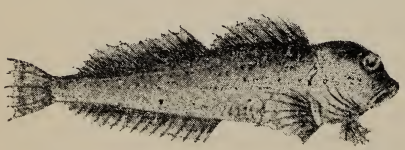

FIG. 45. COMMON SMOOTH BLENNY (BLENNIUS PHOLIS)

Blennies are most amusing little pets for anyone to keep; they speedily become perfectly tame, and will take pieces of meat from the hand. I had two for a considerable time, which were a source of deep interest to all who witnessed their behaviour. In the middle of the tank was a flat rock, projecting above the water. On holding a small piece of meat above this rock, the Blenny would instantly jump on to the top of it; and, indeed, these little creatures are almost

as happy out of the water as in it. The aquarium-keeper will be much surprised at first to find that occasionally (generally at night) the Blennies will leave the water and perch on the top of the rock, in the middle, looking for all the world like a miniature colony of seals. The natural supposition is that they are accustomed to be left in damp seaweed, &c., by the

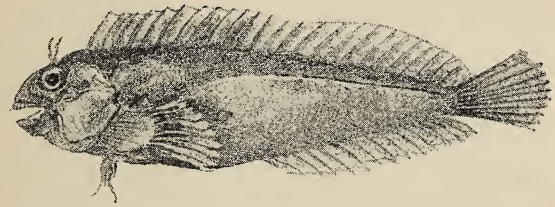

FIG. 46. GATTORUGINOUS BLENNY (BLENNIUS GATTORUGINE).

receding tide; indeed, if any are to be sent inland, they will travel with the greatest ease by post in a tin box, packed in damp seaweed, and will arrive quite frisky at their journey's end. One curious habit of theirs is that of turning "as white as a sheet" (from fright, presumably) when they are removed while the tank is being cleaned out. On being reinstated in their accustomed abode, their spirits speedily revive, and their

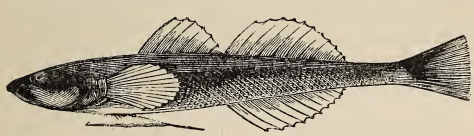

FIG. 47. FRECKLED GOBY (GOBIUS MINUTUS).

colour returns. The Blennies mentioned above were so tame that they would allow me to stroke them, while sitting on the rock, without being alarmed in the slightest degree.

Another and less common species of this genus is the Gattoruginous Blenny (*Blennius Gattorugine*, Fig. 46).

The Freckled Goby (*Gobius minutus*, Fig. 47) is also a very

easily-kept species; it will live for several years in confinement, and soon becomes exceedingly familiar with its owner.

The common Grey Mullet (*Mugil capito*, Fig. 48) is found in plenty on our own coasts, and can be kept in an aquarium without much difficulty. The owner must, however, be careful to put a cover over the aquarium, or this fish will jump out, and be sacrificed to its own rashness, It is a difficult fish to catch,

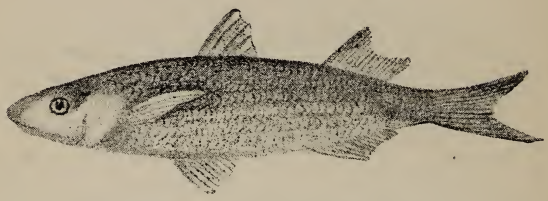

FIG. 48. GREY MULLET (MUGIL CAPITO).

as it will jump over the edge of the net into the sea again if it possibly can.

Another hardy little fish sometimes found in rock-pools is the Butter-fish, or Spotted Gunnell (*Gunnellus vulgaris*, Fig. 49). It is a hard matter to catch this fish, as its body is covered with a slippery secretion, from which it derives its popular

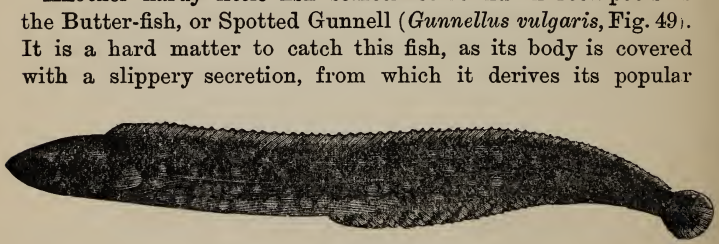

FIG. 49. SPOTTED GUNNELL (GUNNELLUS VULGARIS).

name, and which enables it to slip through the hand without difficulty; and as it can get into the smallest possible crevice, into which the net cannot enter, its chance of eluding its pursuer is considerable. However, when caught it is an interesting inhabitant of the tank, in which it will make itself quite at home in a very short time. In the Orkney Islands, the Gunnell commonly goes by the name of Swordick.

No one whose acquaintance with the tribe of flat fishes only extends to their appearance on the fishmonger's slab, would imagine that they are at all graceful creatures when alive. Even when seen in an aquarium, if still and motionless while sitting on a stone, a flat fish is a very uncanny-looking creature; but when seen swimming, it forms a most graceful object, as not only its tail, but the whole of its body, moves in undulating curves, and the dark brown of the upper side, contrasting with the silvery white of the lower, adds greatly to the effect.

Small specimens of flat fish—Plaice, Flounders, &c.—may be obtained in immense numbers by "tipping" a shrimper to give you the contents of his net. He catches all manner of fishes, but, as he only wants shrimps, the other kinds are all thrown back into the sea again. For the trifling sum of threepence I have thus completely filled my collecting-can with fishes of various kinds. The shrimper will think you are "a bit cracked to want them things," which he looks upon as mere rubbish; but as long as you are satisfied, and he gets the threepence, he will be delighted to humour you in the extraordinary form which your insanity takes!

The common Conger Eel is easily kept in its infancy. One in my possession existed for a period of over six years. When first caught it was only about 3in. long, but at its decease it was nearly 1ft. long, and proportionately stout—far too large a fish for the size of the tank in which it lived. The habits of the Conger Eel are not particularly sociable. As a general rule, he will reside among the gravel, right under the rocks, and does not show himself much except at night; but he speedily becomes extremely tame, and will take meat from the end of a long stick if it is pushed down to him. He has a tremendous appetite; and if some smaller eels are introduced into the tank with a large specimen, they will probably share the fate of the fat kine in Pharaoh's dream before many days have elapsed.

The Wrasses are by far the most highly coloured of our English fishes, and, being hardy, are easily kept in an aquarium. According to Mr. Gosse, the Ancient Wrasse (*Labrus maculatus*, Fig. 50) is the most gorgeous of the tribe. Its colours are generally

red and green—in one of the most beautiful varieties the green is almost obliterated, appearing only on the head and shoulders; the body is brown above, softening to silvery-white on the sides, and covered with a network of deep vermilion, the meshes being irregular, but massive, and extremely rich in effect. The fins are often orange, with bands or spots of transparent green.

A most remarkable peculiarity about the Blennies and Wrasses is that they possess the power, in common with a few other fishes, of moving their eyes independently of each other, or in unison, at will—a faculty formerly supposed to belong exclusively to the chameleon. The effect when the observer is in such a position that he can see both eyes, and the fish is

FIG. 50. ANCIENT WRASSE (LABRUS MACULATUS).

gazing at him with one eye, and with the other looking equally intently at some object on the other side of the aquarium, is singular in the extreme.

The Dragonets, or Skulpins, are a tribe of small fishes which are to be found on the English coast, and are very well suited for the aquarium. The adult male, called the Yellow Skulpin (*Callionymus Lyra*), is a magnificently-coloured fish, but is not very common, the younger males and females being more easily found. These latter are of a more dowdy hue, being of a reddish-brown colour, from which fact they are sometimes called Foxes. The adult male, on the other hand, is of a bright yellow colour, with spots and stripes of blue distributed freely on its head and sides, while the under surface is a silvery white. In Scotland this fish is known as the Gowdie. Being

so different in colour to the females and younger males, it was formerly thought to be a different species, until Dr. Günther, having investigated the matter, proved that they are all really the same, and that it is simply the age of the fish that causes the difference in vividness of colouring. The shape of the Yellow Skulpin is remarkable, the first dorsal ray extending to the tail in a full-grown specimen, and rising above the back in a bold curve. Specimens of the Dragonet may possibly be secured amongst the refuse of the shrimper's net, in which they are often caught.

The common Pipe-fish (*Syngnathus lumbriciformis*) is an extremely interesting inhabitant of the tank, and adds variety to the contents, as it is long and thin in shape, and glides gracefully in and out of the weeds. The general colour of this fish is a yellowish olive-green, becoming silvery grey on the under side of the tail. On the sides of the head and neck are hundreds of spots of pure white, of different forms and sizes, each having a border of black round it, which greatly heightens the effect. The whole of the remainder of the body is spotted and streaked with bands and spots of black and white. The mouth of the Pipe-fish is of a peculiar shape: the muzzle is sharply narrowed, directly in front of the eyes (looking at it from the side), and is a little wider towards the tip, and the mouth opens perpendicularly instead of horizontally. The eye of the Pipe-fish is very beautiful: it is very large, and the pupil is encircled by a red ring, the iris being marked with alternate bands of grey and brown, which increase in breadth as they extend outwards. The motion of the fish while swimming is particularly graceful: it sometimes suspends itself in mid-water, the head being near the surface, on the look-out for any small fly or insect which may be unlucky enough to tumble into the tank; often *vice versâ*, the tail being near the surface, and the head at the bottom of the tank. In swimming, it sometimes twists its snake-like body into various contortions, as if tying itself in a knot: at other times it is extended at full length in the water. The tail, which is very long and tapering, is used in the same way as that of a monkey, except that, whereas the monkey uses his tail to suspend himself from the

branch of a tree, the Pipe-fish uses his to anchor himself firmly to the seaweed, and to resist the onward rush of the water around him in the ocean.

Another remarkable feature of this extraordinary fish has yet to be described: this is the pouch in which the eggs are hatched, and in which the young remain in safety for a time after hatching. This formation is somewhat analogous to the pouch of the kangaroo, and all the marsupials, among terres-

FIG. 51. SEA-HORSES (HIPPOCAMPUS BREVIROSTRIS).

trial creatures. But, oddly enough, in the case of the Pipe-fish the pouch belongs not to the female, as in the case of the kangaroo, but to the male. A long flap of skin runs from the tail, on either side of the under part of the body, and these flaps form the pouch, the eggs being deposited between them. The young, when hatched, leave the pouch at intervals for exercise, and return to it after a sufficient period has elapsed. In the aquarium, the Pipe-fish will remain quiescent among the weeds for the greater part of the day, but will come out

at intervals for a gambol in the open water, when the motions described will be observed.

To the same family—*Syngnathidæ*, or Pipe-fishes—belongs that curious and unique denizen of the sea known as the Sea-horse (*Hippocampus brevirostris*, Fig. 51), whose individuality has so forced itself upon public notice that many people are acquainted with its shape who have never seen one in the living state. In the aquarium it is of a lively disposition, and, as it is hardy, it can be easily kept. For this creature the aquarium-keeper will probably have to resort to the dealer, as it is hardly likely that he will come across one, unless he is exceptionally fortunate. The tail of this fish is used, as is that of its relative, the Pipe-fish, to anchor itself to the weeds, &c., when it would otherwise be carried about by the movement of the water; this characteristic is shown in Fig. 51.

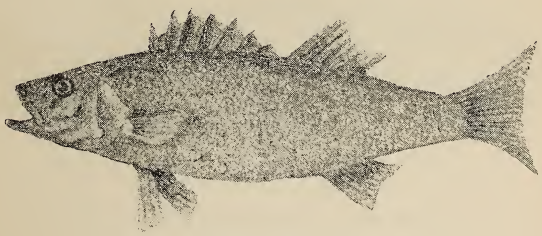

FIG. 52. BASSE (LABRAX LUPUS).

The investigations of Mr. Savile Kent, at the Manchester Aquarium, seem to show that Hippocampi can communicate with each other by certain sounds, these being produced by the muscular expansion and contraction of the lower jaw. These fishes, when in the open sea, live mainly on a minute crustacean known as the Opossum Shrimp (*Mysis Chameleon*), which is captured in a singular way. The Sea-horse swims quietly behind the Opossum Shrimp till within a suitable distance, when he opens his mouth sharply. This, of course, causes a sudden and violent influx of the surrounding water, which carries the unhappy crustacean into the mouth of its destroyer, by whom it is immediately swallowed.

To the Sea-horse also belongs the power of moving its eyes independently of each other; but it seems doubtful if it is able to move them *together*.

The Basse (*Labrax lupus*, Fig. 52), or, as it is sometimes called, the Sea-dace, is a very good fish for the tank, on account of its hardiness. It is in the habit of hanging about jetties and quays, from which it may be angled for with a rod and line, taking care not to injure it, when caught, in extracting the hook. This fish may be recognised by its close resemblance to the fresh-water Perch. It does not mind the absence of salt in the water, and specimens have been removed to a lake some distance inland without suffering from the change. The colours of the fish are dark blue above and silvery white below.

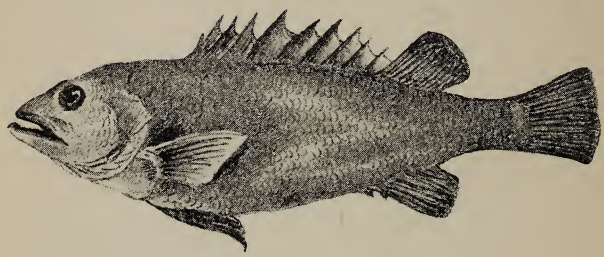

FIG. 53. STONE BASSE (POLYPRION CERNIUM).

Another fish known by the name of Basse is the Stone Basse, or Wreck-fish (*Polyprion cernium*, Fig. 53). It is often met with in immense swarms, accompanying pieces of a wreck to which are adhering a colony of the Necked Barnacle (*Pentalasmis anatifera*), which will be described in Chapter XIII. From the fact that these fishes are nearly always found under such circumstances, it has been thought that the barnacles form their natural food; but this does not seem to be the case, as, in specimens of the fish that have been opened, only small fishes were found, proving that their natural sustenance is obtained from their smaller brethren, these probably following the barnacles in pursuit of insects surrounding them, and thus attracting the Stone Basse.

There is a particularly remarkable fish which rejoices in as many different cognomens as the members of the Bill Sykes fraternity. This is represented in Fig. 54; it is known, according to the locality in which it is found, as the Pogge, the Sea-poacher, the Lyrie, the Pluck, the Armed Bullhead, and the Noble. Even its scientific names also vary, as it may be called, according to the will of the speaker, *Aspidophorus Cataphractus*, *A. europœus*, *Cottus Cataphractus*, or *Cataphractus Schoneveldii*. This fish is often found by shrimpers, in searching for shrimps and prawns, in the dense masses of seaweed which overhang the rocks or the end of a jetty or quay. It is very singular in appearance, being clothed in a complete suit of armour from head to tail. This is formed of a succession of plates in longitudinal lines down the body, each of which has a

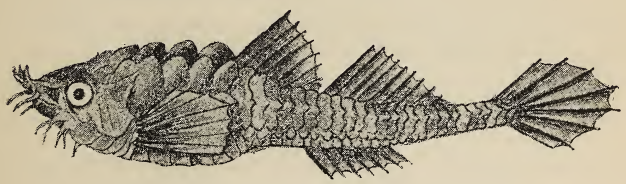

FIG. 54. POGGE (ASPIDOPHORUS CATAPHRACTUS).

projecting portion rising above its surface, so that the body has eight sharp ridges running down it from the head to the tail. It has an enormous head, covered with spines, and the nose ends in three spines that stand erect, and project backwards in a way that reminds the beholder of the horn of a rhinoceros. Under the head grows a beard of stiff, horny hairs, which are very thick, and hang straight downwards. The colour of the fish is brown above, with four broad bands of a darker brown; the under part is white, the fins having a bar of dark brown across the middle.

The common Stickleback of the fresh-water aquarium has a relative in the sea-water tank. This is the Fifteen-spined Stickleback (*Gasterosteus spinachia*, Fig. 55), which, from its elongated shape and protruding jaws, is sometimes called the

Sea Adder. The tail of this species extends much farther beyond the body than that of the fresh-water Stickleback, and is more slender and tapering. Its under jaw projects beyond its upper one, which formation shows that the fish habitually takes its food from a higher level than that of its own body. The fifteen spines, when erected, form an efficient protection

FIG. 55. FIFTEEN-SPINED STICKLEBACK (GASTEROSTEUS SPINACHIA).

against the foes of its race. This species is rather a voracious fish, and care should be taken not to insert it in a tank with other valuable specimens smaller than itself. The colours of the fish are dark brown and white, these colours being in the form of spots and streaks along its sides. This fish would probably bear removing to fresh water, as it belongs to the tribe which naturally inhabits it. The common fresh-water Stickleback will

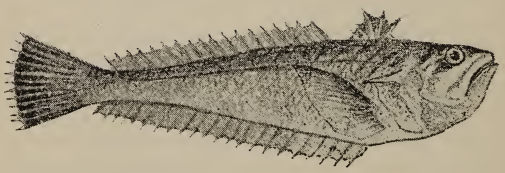

FIG. 56. STING-BULL (TRACHINUS VIPERA).

live in sea water, and I have frequently found it in a rivulet flowing from a pond into the sea, by which means, of course, it must have become accustomed to the salt water, and, when the tide was up, must have been carried out into the open sea.

The fish known as the Sting-bull, or Lesser Weever (Fig. 56), is much dreaded by fishermen, notwithstanding which they are caught in large numbers, especially in France, as an article of

consumption. The fear which it inspires is due to the severe wounds which it inflicts, on those who handle it rashly, by the use of a strong array of spines on its back and gill-covers. In its specific name (*Trachinus vipera*) may be seen again the recognition of its stinging powers. It is a moot point whether any poison is injected into the wound by the spines, or whether only a severe wound is inflicted; but from the large percentage of cases which prove fatal, it seems likely that some poison is injected. If the reader should happen to get "stung" by a Sting-bull, the treatment recommended by Mr. Crouch is the smart friction of the wounded part with olive oil. The colours of these fishes are light olive dashed with red on the upper part, the under parts being white, and the sides silvery grey with a little blue about them. The Sting-bull is not a particularly interesting fish in the tank, as it lies at the bottom usually on the look-out for prey, darting forward suddenly when it sees its victim, which it seldom fails to secure with the first snap of its jaws.

FIG. 57. TWO-SPOTTED SUCKER (LEPIDOGASTER BIMACULATUS).

The Sand-launce (*Ammodytes lancea*) is an interesting inhabitant of the tank, and is easily kept in confinement. If one is kept, it should be provided with a bank of sand, into which it will be seen to burrow, the formation of the head—the lower jaw projecting considerably beyond the upper—being apparently given to it in order to scoop a hole quickly in the wet sand, into which it dives with great rapidity. It is very common on some shores, and is used by the fisherman as a bait. The form of the fish is long and slender, and its colour is almost entirely silver, with a tinge of brown here and there. On the Sussex coast it is known by the realistic name of the Riggle.

A very small but lively fish is the Two-spotted Sucker (*Lepidogaster bimaculatus*, Fig. 57), which is flat in shape, and has a broad, flat head, terminating in a rather sharp peak at the mouth. Its eyes are exceptionally brilliant, the pupil being of a deep green, and the iris of a vivid orange. The common name

is given to it on account of the peculiar formation of its ventral pair of fins, which are joined together so as to form a disk, which was thought to be a sucker. It seems probable, however, that the adhesion of the fish to a smooth rock (which is the characteristic position of this species) is caused, not by suction under the disk, but by a number of smaller suckers which are placed before and behind the joined fins. These fishes are very hardy, and will live for several years in an aquarium. They are very active, and continually flitting about in various parts of the tank; and as they are very brightly coloured with brown, red, and yellow markings, they are an attractive addition to the collection. Care, however, must be taken that they do

FIG. 58. FATHER LASHER (COTTUS BUBALIS).

not jump out of the tank, which they have a bad habit of doing.

Sometimes an investigation of the dense masses of seaweed overhanging rocks at high water will bring to light the remarkable little fish known as the Father Lasher (*Cottus bubalis*, Fig. 58), or, in the North, by the name of the Lucky Proach, which is a very oddly-shaped creature, having a very large head and a wide mouth, with big, staring eyes. It is well armed with prickles and spines. The colour is a deep rich brown above, mottled with black, white, and grey, of different shades. Its sides and the under portion of its body are a silver-grey. It is a capital fish for the tank, as it is very hardy, and soon becomes very bold in its new habitation. It will soon learn to come to the surface and take pieces of meat from the hand of its owner. It will live for some time out of water if kept

moist, and could therefore be sent some distance inland, if packed in moist seaweed.

One of the most familiar objects on the seashore is the egg of the common Thornback Skate (*Raia clavata*), and specimens of the fish itself are often captured in a dredge. When young, these fish are decidedly more prepossessing in appearance than the full-grown specimens captured for the market, and exhibited on fishmongers' slabs. The movement of the fish is effected by the rapid undulation of the broad pectoral fins. Yarrell, in his book, describes the motion as being between flying and swimming. On the head will be seen two orifices, which are constantly opening and closing, and present the appearance of eyes. They are not so, however, but are the spiracles, or openings of the gills. The eyes are two small knobs just in front of the spiracles. The colours of the fish are warm olive-brown, with patterns of black and pale-coloured spots upon it. The under surface is iridescent, resembling mother-of-pearl.

The Lamprey (*Petromyzon marinus*, Fig. 59) has, at any rate, the merit of being rendered immortal in English history. It

FIG. 59. LAMPREY (PETROMYZON MARINUS).

is really a marine species, but often ascends rivers for the purpose of depositing its spawn, and has even been known to get up the Thames as far as London, in spite of the numerous obstacles, such as quays, &c., with which it meets on its way. The true river species is known as the Lampern (*Petromyzon fluviatilis*). Small specimens of Lamprey may be kept in the tank, but it has the reputation of being a voracious fish, and causing the death of others larger than itself, by fastening upon them and eating the softer portions of their bodies.

There is a group of animals which are called "fishes," and may be mentioned in this chapter; but they have really no relationship to the finny tribes at all, being members of the

class known as Radiates, or *Echinodermata.* These are the Star-fishes, of which the common Five-finger (*Uraster rubens*, represented in front of the Green Shore-crab in Fig. 79) is most frequently met with tossed up by the waves on the beach, hundreds of them being sometimes cast up by a gale.

This species is worth a little attention, common though it is. If a Star-fish is turned upside down, an immense number of "ambulacra" (or feet, if you prefer to call them so) may be seen, by means of which the Star-fish manages to get along at a tolerable pace. It is even able, with a little manœuvring, to turn itself over if laid on its back. In gliding through the water, it accommodates itself with wonderful dexterity to the shape of objects over or through which it passes.

This species must not be placed in an aquarium with other live stock, especially molluscs, or it will contrive to devour a considerable number. Specimens may be kept for a long time in a separate vessel, if plenty of room and water are given to them, and not much light is allowed to penetrate to the vessel. When its life comes to a termination, the best thing to do is to put it into a box with small holes cut in the sides, and place it on the ground near an ants' nest. In process of time the ants will enter through the holes, and devour all the animal substance, leaving only the skeleton, which forms a most beautiful object, being composed of rows on rows of minute pillars, of glistening whiteness. Even oysters are devoured by this animal: it seems to bring its mouth in contact with the edge of the shell, and pour into the oyster a poisonous fluid, which is apparently bestowed upon the Star-fish for that purpose; the effect being to cause the oyster to open its shell, and finally to kill it. The colour of *Uraster rubens* is generally a brownish red on the upper side; some are of a purple or violet colour, but these are thought by some people to be a different species.

There is another Star-fish which is much more prominent in appearance. Instead of only five rays, this species has twelve; they are much shorter than those of the Five-finger, and all proceed from a large disk, which, giving it a likeness to a painting of the sun, has caused it to be popularly denominated

the Sun-star (*Solaster papposa*, Fig. 60). These creatures are very gaudily coloured, being usually of a bright red, sometimes tinged with violet; while occasionally specimens are found in which the rays are much paler in colour than the disk.

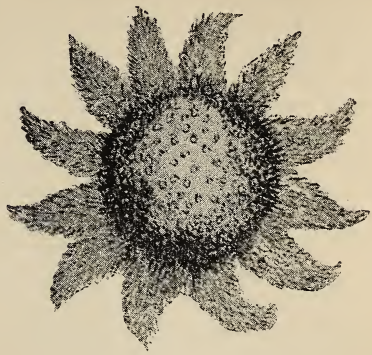

FIG. 60. SUN-STAR (SOLASTER PAPPOSA).

The common Brittle-star (*Ophiocoma rosula*, Fig. 61) is a nearly-allied species, and is very common on all our coasts, dozens being brought up by a dredge in a favourable locality. The difficulty in keeping these creatures is due to the habit whence they derive their popular name—namely, that of flinging off their limbs without a moment's hesitation, and so breaking themselves into fragments, when alarmed. If a tolerably perfect specimen can be moved to the tank without destroying itself, it will be an ornament to the collection, as the Brittle-star is a very striking and handsome species, some specimens being marked with alternate bands of orange, yellow, crimson, purple, blue, and white.

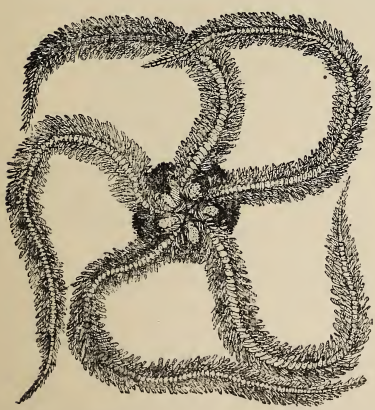

FIG. 61. COMMON BRITTLE-STAR (OPHIOCOMA ROSULA).

The most brittle species of Star-fish known is the Lingthorn (*Luidia fragillissima*), specimens of which can hardly ever be seen in

the perfect state. Professor Forbes, in his "History of British Star-fishes" (p. 139), has given a ludicrous account of his endeavours to capture one and put an end to its existence before it had time to commit suicide. He had gone out with a bucket of cold, *fresh* water, hoping that, by lowering the bucket into the sea, and quickly placing a star-fish in it, the fresh water would kill it instantaneously, before it had time to cast off its arms. His efforts were, however, totally unsuccessful. He says: "Whether the cold air was too much for him, or the sight of the bucket too terrific, I know not, but in a moment he proceeded to dissolve his corporation, and at every mesh of the net his fragments were seen escaping. In despair, I grasped at the largest, and brought up the extremity of an arm, with its terminating eye, the spinous eyelid of which opened and closed with something exceedingly like a wink of derision!"

One rather rare species of Star-fish—the Long-armed Brittle-star (*Ophiocoma brachiata*)—has its arms very much out of proportion to its body, the former being 7in. or 8in. long, while the latter is scarcely $\frac{1}{2}$in. across.

The smallest species of British Star-fish is the Little Cross-fish (*Uraster hispida*), of which specimens measuring more than $1\frac{1}{4}$in. across are seldom found, even when full grown.

CHAPTER XI.

SEA-URCHINS AND MOLLUSCS.

THERE is a tribe of animals which claim a close relationship to the Star-fishes, but which, in external appearance, are entirely dissimilar to them. I refer to the *Echinidæ*, or *Cirrho Spinigrade Echinodermata*, all of which go by the popular name of Sea-urchins. Let the reader imagine a tennis-ball, with one side considerably flattened, in which an immense number of dark green pins have been stuck in a slanting direction, and he will have an idea of the appearance presented by the common Sea-urchin, or Sea-egg, as it is sometimes called (*Echinus sphœra*), or of its congener, the Purple-tipped Urchin (*E. miliaris*, Fig. 62), which is so called from the fact that each of its spines is tipped with purple. The latter species may be found on the shore mixed with specimens of the Sea-egg. There are many other species of Sea-urchin, but these two are most frequently met with. The Echinus in no way resembles the Star-fish in its general appearance, but when denuded of its spines the similarity of its structure is easily demonstrated. Suppose that a Five-finger Star-fish is taken, and the tip of each ray bent over, and sewn to the outside of a circular disk of card-

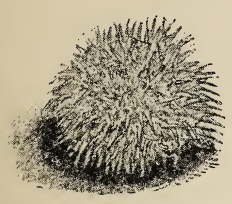

FIG. 62. PURPLE-TIPPED SEA-URCHIN (ECHINUS MILIARIS).

board which is larger than the body of the Star-fish—this would precisely resemble the case of an Echinus. This case is one of the most wonderful examples of elaborate construction in the whole animal creation. It is evident that as the Echinus grows it will get too large for the case, as it cannot shift its quarters in the manner of the Soldier Crab. How, then, is the case to increase in size so as to accommodate itself to the growth of the animal within it? It is managed in this way: If the shell of the Echinus is examined, it will be seen to consist of an immense number of pentagonal plates, each of which fits into its place like parts of a puzzle, and these give to the whole its natural shape. As the animal grows, lime is deposited round all the edges of each plate simultaneously, so that the shell increases in size equally all over, and the shape remains unaltered.

The spines are organs of locomotion, in addition to the sucker-feet which the Echinus possesses in common with the Star-fish. From these spines is, of course, derived its popular name, the name of "Urchin" being given to the hedgehog (which the Echinus is supposed to resemble) by the rustics in country places, and especially by gipsies, who are very fond of eating that animal roasted.

The Echinus possesses a very large mouth, which is placed in the centre of its body; in it there are five small teeth, the hardness of which can be tested with the finger.

I have not found the Echinus a particularly lively inhabitant of the tank. Those which I have kept rarely moved from the position in which I placed them. It is said that by means of their suckers they can crawl up perpendicular surfaces of glass, &c., and I was constantly expecting them to ascend the glass sides of the tank, which, however, they never did.

If the Echinus comes to an untimely end, the shell can be preserved by simply extracting the animal, and then drying it. If the spines are taken off, it presents a most beautiful structure, the plates standing out clearly when not surrounded by the membrane of the living animal.

We now proceed to consider the members of the tribe of Molluscs which are suitable for the tank, some being admitted for use, and others for ornament.

If the aquarium is placed in a light situation, the seaweeds will generate their spores abundantly, and these, settling on the glass sides, will soon render it nearly impossible to see the inhabitants, unless some measures be taken to keep the glass clean. There are, however, numbers of animals well suited for this task. The searcher after marine specimens, when diving about among the seaweed on the rocks at low water, is certain to come into contact with numbers of little yellow shells, which are inhabited by a small creature claiming close relationship to the common Periwinkle. This is the Yellow Periwinkle (*Littorina littoralis*, Fig. 63). This mollusc is not easily kept in the tank, as it is accustomed to be left high and dry on the rocks, by the tide receding, for the greater part of the day, and will not live for long when compelled to remain in the water. Its congener, however, the common Periwinkle (*Littorina littorea*, Fig. 67), will live for a very long time, and keep the glass clean by continual exertions.

FIG. 63. YELLOW PERIWINKLE (LITTORINA LITTORALIS).

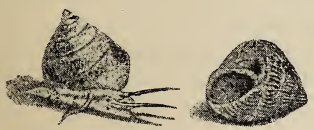

FIG. 64. TOPS (TROCHUS CINERARIUS).

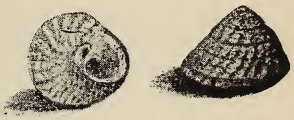

FIG. 65. TOPS (TROCHUS UMBILICATUS).

Very few people have any idea what a handsome creature the common Periwinkle is when alive and enjoying himself. The body of the snail is covered with a delicate network of black stripes, and his horns are banded in the same way, giving him a very zebra-like aspect.

Handsomer and more interesting species, all of which go by the familiar name of Tops, are to be found in almost as great abundance on our shores. There are, however, known to be several members of the family, the two commonest being

Trochus cinerarius (Fig. 64) and *T. umbilicatus* (Fig. 65). The shell of the former is of a dull purplish grey, marked with close-set, zigzag lines. That of the latter is rather flatter in shape, and of a dull olive or green colour; it has narrow reddish bands radiating from the centre. Another tolerably common species is *T. ziziphinus* (Fig. 66), which is rather larger, and much more striking in appearance; it has a shell which rises gradually to a peak, and is beautifully marked, generally with red and white.

FIG. 66. TOPS (TROCHUS ZIZIPHINUS).

The manner in which the Trochus sets to work to remove the green confervæ on the glass is exceedingly interesting to witness. With its long tongue (which, by the way, forms one of the most interesting microscopic objects in the animal creation, with its rows on rows of teeth) it removes the green in a circular sweep; then its tongue is withdrawn, and the foot makes a step forward, the head meanwhile moving across to the opposite side; then out comes the tongue again, and another sweep is made; and so on, the whole operation instinctively reminding one of a mower with his scythe cutting down swathe after swathe of grass.

Another shell which is easily found on all our shores goes by the name of the Dog Winkle, its scientific name being *Purpura lapillus*. This is well adapted for the aquarium; it is, however, very voracious, and will devour other molluscs it may come across. The animal is interesting, owing to the fact that from it was obtained the purple dye which the ancients used only for the vestments of kings. If any reader wishes to test this, let him procure a Purpura, and, first breaking the shell with a hammer, drop the animal into some fresh water, by which means it is speedily killed (if the shell is not first broken, the animal will not be killed by the fresh water for some hours). When quite dead, examine the mollusc

carefully, and a sac will be found running transversely across the body, which contains yellow or cream-coloured matter. This is the dye in question, which, if spread carefully on a piece of calico, will be found to change its colour on exposure to light, becoming first light green, then grass-green, then bluish green, then changing to indigo, and thence

FIG. 67. COMMON WHELK (BUCCINUM UNDATUM) AND COMMON PERIWINKLE (LITTORINA LITTOREA).

to blue. A red tinge now comes in, which gradually causes the colour to become violet, and then purplish red. Finally, it assumes a dull purplish-crimson—the final colour. Supposing that the sun is allowed to shine on the calico, the changes take place with considerable rapidity, but on a dull day they take some hours.

The aquarium-keeper will, perhaps, think it worth while to hatch some of the eggs of the common Whelk (*Buccinum undatum*, Fig. 67), bunches of which may often be found on the shore at the beginning of summer. They are nearly round in shape, and the clusters are not unlike bunches of grapes. Inside the transparent substance which forms the exterior may be seen the young whelk, which remains in the glutinous envelope until it is strong enough to shift for itself. If simply placed in the aquarium they will hatch of their own accord, but will speedily fall victims to the fishes. Full-grown Whelks may be found in profusion, but it is hardly safe to introduce them into the tank, as they are very ravenous, and will devour the other molluscs. For this reason they are called by the fishermen Sea-wolves. Even the oyster is eaten by the Whelk, which is provided with a special apparatus for piercing the shells of its victims.

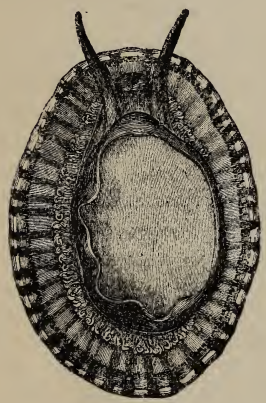

FIG. 68. UNDER SIDE OF COMMON LIMPET (PATELLA VULGATA).

There are two varieties of Limpet which can be kept in the tank if desired. One is the common Limpet (*Patella vulgata*, Fig. 68), which can be found in thousands on almost any coast where there are rocks; the other is the Smooth Limpet (*P. pellucida*, Fig. 69), which is a much more elegant species, its shell being very nearly transparent, and brightly coloured with blue, chocolate, yellow, or red. If tufts of the algæ thrown up by the waves are examined, or if a quantity is pulled off from the rocks, some specimens of this Limpet will frequently be found among the fronds. The common Limpet adheres so tightly to the rock that it is very hard to dislodge it without injury. The adhesion is caused by a wonderful piece of mechanism, which may be seen when the creature is fastened to the glass side of the tank. It is exactly analogous to the toy known as the sucker (made from a piece of wet leather with

a hole in the middle, through which passes a piece of string), which is a source of amusement to the juvenile portion of the population. If the leather disk, when wet, is pressed firmly on to a flat stone, and the string pulled, a vacuum is formed, and the pressure of the external air is so great that the leather is immovably fastened to the stone, which can therefore be lifted by the string, even if its weight is considerable. The Limpet uses its soft body in a precisely similar way, its internal organism enabling it to raise the centre portion of its disk, whereby the pressure of the air fixes it immovably to the rock. Recent investigations seem to point to the fact that, in addition to this process, the Limpet possesses a natural secretion, which acts as glue, and sticks the creature still more firmly to the rock. This can be dissolved again at the will of the Limpet, thus setting it free. The process of glueing, however, takes a few seconds to carry out, and therefore, if a sudden snatch is made at a Limpet, it will sometimes come off the rock before it has time to fasten itself down. By the constant adherence of a Limpet to the rock, the latter is gradually worn into a hole, which renders the position of the creature still more secure. The Limpet leaves its hole at intervals, chiefly in the night, and sallies forth in search of food, returning to the hole when it betakes itself to rest. It is thought by some naturalists that a Limpet always returns to the same hole. If the reader feels any curiosity on this point, he can easily settle the question for himself by marking the shell and the hole similarly by means of paint, and observing if the Limpet is always found in the hole marked the same as its own shell.

FIG. 69. SMOOTH LIMPET (PATELLA PELLUCIDA).

The common Edible Sea-mussel (*Mytilus edulis*, Fig. 70) is an exceedingly plentiful species, but is none the less a remarkable creature on that account. Its chief peculiarity consists in the *byssus*, as it is called, by which it is enabled to anchor

itself to a rock. This appendage is formed of very strong, yet silky, fibres. In some members of the family, such as the great Fan-mussel, or *Pinna*, which is common in some places on our coast, especially off Plymouth, the byssus is considerably larger, measuring in some specimens over 2ft. in length.

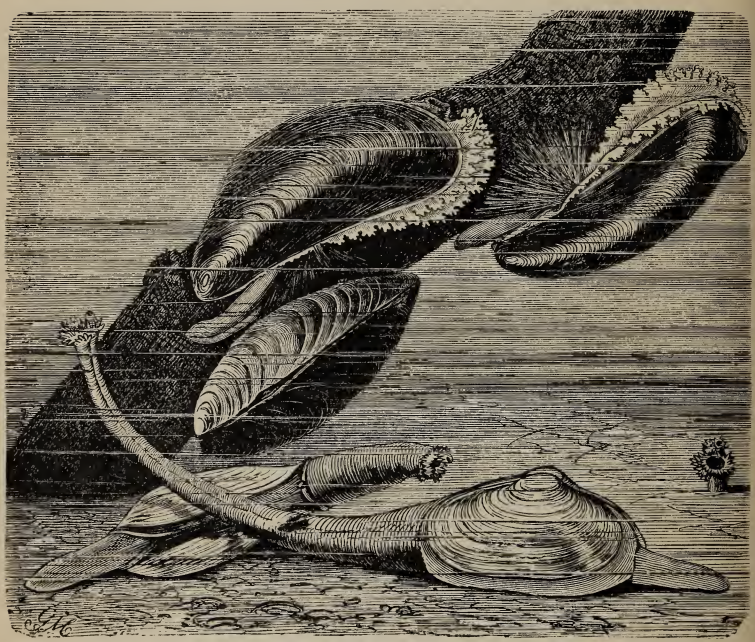

FIG. 70. EDIBLE SEA-MUSSEL (MYTILUS EDULIS), AND SAND-MUSSEL (MYA ARENARIA).

Purses are sometimes netted with the silky fibres of this appendage.

In the foreground of Fig. 70 is seen a figure of the Sand-mussel (*Mya arenaria*). This Mussel is provided with a much elongated siphon, which it utilises for breathing purposes when its body is buried some distance beneath the surface of the sand.

The siphons in this species are double, and the water passes up one and down the other. This mollusc burrows until nothing is visible but the tip of its siphon. The appearance of the top of the siphon when the mussel is buried is shown in the vacant space on the right of the illustration.

The common Scallop (*Pecten jacobœus*) is very easily found, and is a really handsome creature when the valves of its shell are open, having a row of points round the margin of the shell

Fig. 71. Common Cockle (Cardium edule).

which closely resemble eyes, and are thought by many to be organs of vision. The Scallop projects itself through the water by expelling a jet forcibly from its body, which drives it along by the reaction from the surrounding water.

The common Cockle (*Cardium edule*, Fig. 71) will live for a few days in the tank, and exhibit the extraordinary appendage with which Nature has provided it for the purpose of locomotion, and which is strangely like the human foot. A sharp look-out must, however, be kept upon it, for it has a bad habit of

getting into a corner and there dying, the first indication of its decease being generally the objectionable odour arising from the tank.

The common Oyster (*Ostrea edulis*) cannot be said to be a particularly intelligent or active being, but, such as he is, he will render the aquarium-keeper good service. The water occasionally, if the tank is kept in too light a situation, will become quite green, from the production of vast numbers of the spores of the seaweeds. The Oyster does much to remedy this evil, for it is provided by Nature with two tubes, through which a constant current of water is kept passing, the exit tube being provided with a filtering arrangement, so that the oyster detains as food all the floating animalcules, confervæ, &c., passing through the tubes. In this way, therefore, he acts as a purifier of the water; and, as he is very hardy, and gives no trouble or inconvenience whatever, it is worth while to keep one or two specimens, on account of their service to the other inmates of the vessel.

The common Squid, or Calamary (*Loligo vulgaris*, Fig. 72), which is a member of the Mollusc tribe, has the same method of locomotion as the Scallop, and, if it can be caught in a net, or hatched from the eggs thrown up on the beach, will form an interesting addition to a collection. When progressing through the water, the Squid appears to move without any means of propulsion whatever, if the water is clear; but if muddy, a close observer will soon detect the motive power. The body of the Squid contains nothing wherewith it can propel itself, and its motion is caused by its siphon, which forms a conspicuous appendage. When the Squid does not wish to move, the water is permitted to flow gently out of the siphon; but when desirous of changing its situation, the water is violently expelled, and the reaction caused by the concussion against the surrounding water sends the Squid spinning along in the contrary direction. The fresh-water aquarium-keeper will recollect that the larva of the dragon-fly propels itself in a precisely similar way. Besides the curious method of locomotion above noted, the Squid has two other peculiarities which are well worth examining. These are the

suckers with which its arms are provided, and the peculiar form of its eyes. The latter are so constructed as to be almost completely achromatic, their form being a sphere of transparent substance with a deep conical groove running round it. If the reader happen to be possessed of a lens known as a Coddington, he will at once see the similarity between the shape of the

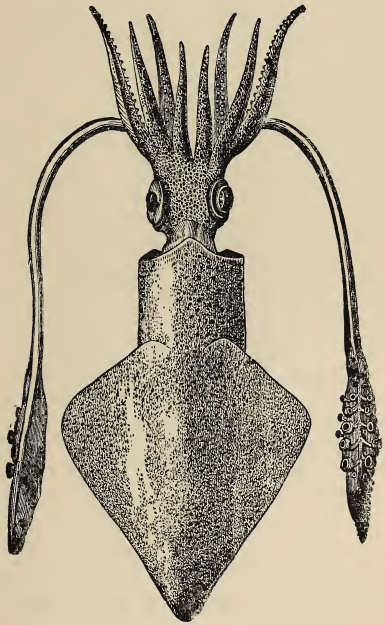

FIG. 72. COMMON SQUID, OR CALAMARY (LOLIGO VULGARIS).

glass and that of the eyes of the Squid. The suckers on the arms are specimens of natural air-pumps. Each sucker consists of a cup provided with a piston. When the piston is drawn up, the cup being pressed against a flat surface, the air is exhausted, a partial vacuum is formed under the cup, and the pressure of the external air holds the sucker firmly

to the surface against which it is pressed. The arm on the

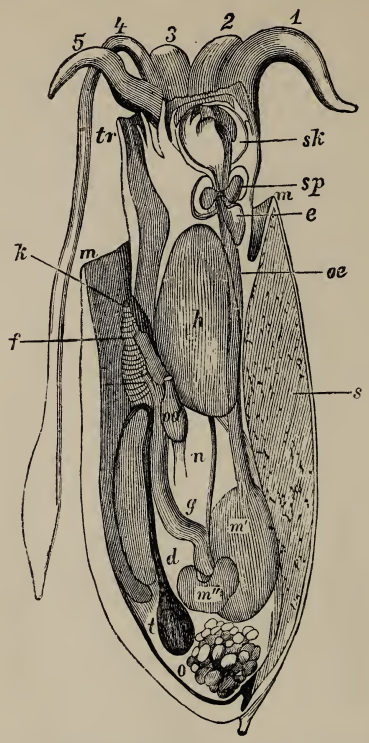

FIG. 73. INTERNAL ORGANS OF THE SQUID, OR CUTTLE-FISH (SEPIA OFFICINALIS).

1, *2*, *3*, *5* Tentacles.
4 Arm.
d Situation of the Dorsal Vessel (Heart).
e Trachea.
f Anus.
g Small Intestines.
h Liver.
k Gills.
m Mantle.
m' Stomach.
m'' Blind Sac of the Stomach.
n Bile-duct.
o Ova.
od Ovarian Duct.
oe Œsophagus.
s Cuttle-bone.
sk Head and Jaws.
sp Brain (Central Nervous Ganglion).
t Ink-bag.
tr Siphon.

right of Fig. 72 is turned so as to show the surface which is covered with suckers. The Calamary has the power of changing

its colour, when desired, from white to brown. This also takes place independently of the will of the animal, and even happens occasionally in dead specimens.

For the benefit of those who are interested in dissections, an illustration (Fig. 73) is given of the internal organs of another member of the Squid family, sometimes called the Cuttle-fish (*Sepia officinalis*). Beginning at the top of the head, we have the tentacles (of which four are shown in the illustration), and beneath these the head and jaws, the brain being below this. Lower down are the organs of digestion, reproduction, &c., inclosed in a case formed by the mantle on one side and the cuttle-bone on the other—this latter occupying a large space compared with the size of the animal. The most interesting portions of the Sepia's internal organs are the cuttle-bone (with which everyone is familiar) and the ink-bag, which is shown on the left, at the bottom of the picture. From the latter the Sepia evolves a large quantity of an intensely black fluid when alarmed, and this, rendering the surrounding water muddy, enables him to make good his escape. This ink can be actually used for writing, and it may afford some moralisers an opportunity for reflecting on the economy of Nature to consider, that thus on one side of the animal we have the ink, and on the other the wherewithal for rubbing it out! Of course, in these small members of the Cuttle-fish family the amount of ink is comparatively minute, and only serves to render the water muddy. In the enormous species of Octopus inhabiting the Atlantic Ocean the amount of ink is considerable, and is sometimes squirted in the faces of their opponents. These large Cuttle-fishes are exceedingly formidable antagonists, and are often introduced into romances of the Victor Hugo and Jules Verne type. Readers of Rider Haggard's works will recollect that the plot of his novel "Mr. Meeson's Will" turns mainly on the use of the ink of the Cuttle-fish.

CHAPTER XII.

NUDIBRANCHS AND ANNELIDS.

THERE is an interesting branch of molluscs which are either destitute of the protecting shell, or have merely rudiments of it. These Sea-slugs, as they are called, are among the most beautiful inhabitants of the aquarium, their chief beauty consisting in the elegant arrangement and colouring of their gills, or branchiæ, as they are scientifically named, which, instead of being inside the body, as is the rule with the other molluscs, are placed outside. These creatures are comparatively common, but need a sharp and practised eye to discover them, as they look totally different when left by the tide to what they do when submerged and expanded.

The largest of our British species is the Sea-lemon (*Doris tuberculata*), which is often found clinging to the under side of stones, but more frequently to the edges of rocks, or underneath projecting ledges. The body of this Nudibranch is of a bright yellow colour, and covered with small excrescences. When crawling under water, it precisely resembles a lemon which has been cut in half; hence its popular name. At the end of the half-lemon, however, is seen a most elaborate structure, which well merits careful investigation. This is formed by the gills, which are feathery, and arranged in a complete circle of plumes. At the other end of the body are the tentacles, which project through the external covering, called the "mantle." *Doris*

tuberculata has the power of withdrawing its tentacles at will, and it is when the gills are retracted that it looks most like half a lemon.

A more brilliant species is the Crowned Eolis (*Eolis coronata*), which, when expanded, is a very gorgeous object, the breathing organs being placed transversely across its back at intervals.

FIG. 74. SEA-SLUG (EOLIS PAPILLOSA), AND ARBORESCENT SEA-SLUG (DENDRONOTUS ARBORESCENS).

The colours of these organs are very vivid: each is quite transparent, with a core of vivid crimson, and the surface blue, the tip being opaque white. Specimens of this species must not be kept in a tank with sea-anemones, as they are very voracious, in spite of their ethereal appearance, and the food which they especially delight in happens to be our cherished Actiniæ.

On the left of Fig. 74 is shown *Eolis papillosa*, a comparatively common species, and a very large one, being sometimes nearly 3in. in length. The branchiæ are arranged in regular rows down its back, almost covering its body. The colour of this species is olive or brown, sometimes light pink, and very rarely yellow.

Doris coccinea is another and showier species, of a scarlet colour, with numerous black spots; its plumes are arranged in a circular tuft, and the tentacles can be withdrawn when it chooses.

The mollusc on the right of Fig. 74 is the Aborescent Sea-slug (*Dendronotus arborescens*). The body of this species is about 2in. long in full-grown specimens. It is coloured very brightly, generally with crimson, variegated with brown, and spotted with white. The branchiæ are especially striking; they are formed into bushy tufts, the branches of which extend on all sides. There are about six or seven tufts on each side of the body, which decrease in size towards the tail. This slug is often found amongst seaweed between tide-marks, and is especially common in the North of England.

The species known as *Doto coronata* is the last Nudibranch that will be mentioned. This is a very remarkable animal, and hardly resembles a mollusc at all: its tentacles spring from sheaths of a trumpet-like form, like the pistil from the centre of a lily; and its gills are very large, and covered with knobs. Its ground-colour is pale buff, studded with purple specks.

The best way to obtain specimens of the Nudibranchs is to gather a large tuft of seaweed, and search for little jelly-like lumps of no particular shape. These creatures should be taken off very carefully, and placed in clear water, where they will soon recover themselves and expand their gills.

There are several species of marine worms which live in tubes made out of various substances (for which reason they are named Annelids), some of which are among the most interesting and beautiful objects in an aquarium. The species of the group *Sabella* construct their tubes of sand. The one best known to aquarium-keepers is *S. alveolaria* (Fig. 75), which is very common on almost any shore. This Tube-worm generally builds

in immense numbers, sometimes several hundreds in one mass. The tube is easily crumbled to pieces, but, there being no lack of material, the Sabella does not take long to construct another; and if some of these creatures are deprived of their tubes, and supplied with plenty of sand, they will construct their houses even in captivity (especially if the vessel containing them is kept in a dark place), thus affording the naturalist an excellent opportunity of studying their habits.

These worms have a ring of beautiful tentacles round their heads, which are very striking when the worm is extended from its tube; they are, however, completely eclipsed by those of

FIG. 75. SABELLA ALVEOLARIA.

FIG. 76. SCARLET SERPULA (SERPULA CONTORTUPLICATA).

the next worm to be described, which has tentacles of the most brilliant description, usually scarlet and white; and when a large mass of the worms are seen expanded, they form about as gorgeous an object as the mind can conceive. This species is known as the Scarlet Serpula (*Serpula contortuplicata*, Fig. 76), and is comparatively common on stones, shells, &c., especially on the Devonshire coast. In the case of the Serpula, one of the tentacles is modified with a conical stopper, coloured scarlet and white to match the rest, with which the worm is enabled to close the entrance to the tube, and thus guard against intrusion. *S. contortuplicata* is an exceedingly sensitive species when first placed in the aquarium, and if the slightest movement is made

in its vicinity when expanded, it shoots back into its tube with such rapidity that to the onlooker it appears to have suddenly vanished into thin air, leaving "not a rack behind." After a time, however, it becomes much more tame, and will permit a close investigation without withdrawing into its tube. The excessive rapidity of the Serpula's action, which is common to all Tube-worms, is rendered possible by the elaborate structure of its body within the tube, which is furnished with instruments not unlike grappling-irons all up its length; and when all these instruments are together brought into violent action, the result is to send the worm, tentacles, stopper and all, back into the tube like "a flash of greased lightning." It is an extraordinary fact, and one much pondered on by marine zoologists, that the shadow of a person passing by, or even a cloud passing over the sun, will cause the worm to shoot back in an instant. This seems to render it highly probable that the Serpula can *see*, but no organs of vision can be discovered, even under the strictest investigation. This creature lives in rather deep water, and is, therefore, not easily obtained, except with the aid of a dredge.

FIG. 77. SERPULA VERMICULARIS.

Another member of the family (*Serpula triquetra*) may be found without much difficulty on the stones and shells, &c., at low water. This hardy species will live for a long time in an aquarium. It derives its specific name from the fact that the tube is triangular, and not circular, as in the case of other worms.

Serpula vermicularis (Fig. 77) is another member of the tribe. The tentacles of this worm are more like separate plumes, and not so feathery as those of *S. contortuplicata*.

A species of tube-builder closely allied to the Sabellæ and Serpulæ can be found in the sand, from which it must be carefully dug out if it is to be placed in the aquarium. This is

known as the Shell-binder (*Terebella Emmalina*, Fig. 78), the popular name sufficiently denoting the substances of which its habitation is composed. If the tube is removed from its back, and plenty of sand, shells, beads, &c., are given to it, it will build up another tube with these materials. There is a resemblance between this worm and the caddis-worm of the fresh-water aquarium, which will also build another tube, if ejected from its old one, and supplied with materials. The tubes of these worms are tolerably tough, unlike the fragile ones of the Sabella or the brittle ones of the Serpula, the materials in this case being bound together by a secretion from the animal itself.

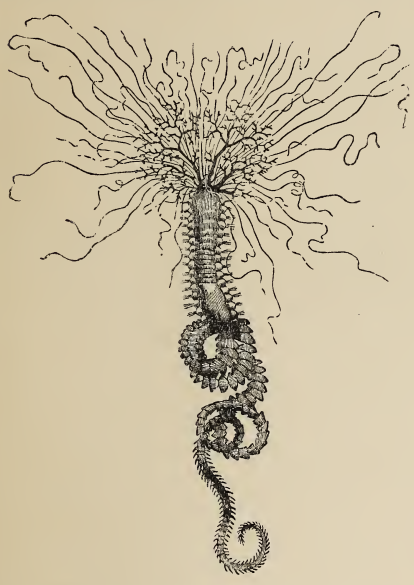

FIG. 78. SHELL-BINDER (TEREBELLA EMMALINA).

Belonging to the tribe of Sea-worms (*Annulata*), but bearing no resemblance to the Serpula, is the familiar object known as the Sea-mouse (*Aphrodite aculeata*). The colours of this worm are gorgeous in the extreme. Its body is covered with a thick mass of hairs, each of which reflects a different colour to the eye, so that the creature appears clad in a kind of rainbow. It is difficult to understand why this magnificent apparel should be bestowed on a creature which chooses as its favourite habitation the black and fœtid mud at the bottom of the sea, and would be hardly ever seen by the hunter after marine animals were it not that the waves are constantly

casting up specimens on the beach. It is not an interesting inhabitant of the tank, as it does nothing but lie perfectly still for the greatest part of its life. Moreover, it will devour more valuable specimens if care be not taken.

A curious animal, resembling the Annelids in appearance, but belonging to a different family, is the Sea-cucumber (*Pentacta pentactes*). This may be found under ledges of rocks, &c., and must be extricated with care from its stony habitation. It is almost a unique example of an animal without a head; but instead of a head it has a magnificent coronet of feathery tufts. The rude shock given to its nervous system by its removal from the rock will probably cause it to collapse entirely for a few days after being placed in the tank. Then it will gradually expand its plumes once more, and find a residence for itself in some congenial corner, under a stone. This particular species bears a strong resemblance to a cauliflower, except as to colour, the stems of its coronet being purplish black, with white papillæ on the top. It throws off its coronet if irritated, but after a time this grows again.

Bathers on some coasts have much reason to dread the larger species of the family known as *Acelephœ*, or Jelly-fishes, the scientific name denoting the possession of stinging properties by many of the tribe. Those that sting seriously, however, are also, fortunately, rare, and inhabit deep water; while those that are of interest for aquarium purposes are often captured by means of a dredge. The best-known is the Sea-acorn (*Cydippe pomiformis*), which is only about $\frac{3}{4}$in. in height. It is a gorgeous object when living; it resembles a soap-bubble, the iridescent tints of the bubble being also present in the Jelly-fish. None of the Acaleph tribe will live long in an aquarium; but while alive they are a great ornament to the tank, swimming about in all directions, and trailing after them their long and feathery tentacles.

CHAPTER XIII.

CRUSTACEA.

AMONGST the crustacea there are many species suitable for the aquarium, and, as their habits are very interesting, they are well worthy of insertion therein

Everyone knows the Green Shore-crab (*Carcinus mœnas*, Fig. 79); he is a favourite with all frequenters of the shore, and may be found in abundance on any coast, varying from a specimen the size of a pea to one whose carapace is 6in. or 7in. across. A large specimen is an awkward creature to tackle, as it can give a severe nip if it gets one's finger within the grasp of its gigantic claws. There is, however, a simple dodge whereby the fiercest may be easily captured. When a crab first catches sight of its enemy, it usually "squats on its haunches," so to speak, and holds out its claws in a threatening manner. Push it forward with the forefinger of the right hand from behind, and hold it firmly against the ground; while thus held, take the body by the thumb and middle finger just behind the claws: as the crab cannot strike backwards, he is completely at one's mercy while thus held.

The crab's shell not being arranged to grow with him, in the way that the box of the Echinus does, he is compelled at intervals to cast his shell, and wait till a new one, of more convenient dimensions, is secreted. While this process is going on he is obliged to hide very closely under rocks, &c., as his shell is then quite soft; and should another crab of a carnivorous

turn of mind come that way, he would certainly fall a victim, being in such a defenceless condition.

The Green Shore-crab will live for an immense time in captivity, but should on no account be placed in the tank, or the choicest specimens will speedily disappear. It is fond of getting out of the water, and should therefore be kept in a flat vessel with a little sand, &c., forming a mound rising

FIG. 79. GREEN SHORE-CRAB (CARCINUS MÆNAS), COMMON SHRIMP (CRANGON VULGARIS), AND FIVE-FINGER STAR-FISH (URASTER RUBENS).

out of the water. In this way I have kept them for a long period. The sides of the vessel must be very high, or a cover must be placed on it, as, if the animal can get one of his claws over the edge, he will be out in the twinkling of an eye.

In the Green Shore-crab the last pair of legs is flatter than the rest—a fact which shows that it really belongs to the family

of Swimming Crabs—though the feet are not flat enough to allow it to use them for swimming. There are several members of the family of Swimming Crabs, all of which are familiarly known by the name of "Fiddlers," from the action of the legs in swimming, which resembles the motion of a man's arm in playing the fiddle. The common Fiddler (*Portunus puber*), or Velvet Fiddler, as it is usually called, on account of the velvet-like hair with which its body is covered, is an exceptionally handsome creature. As a general rule, its body is of a chocolate-brown, while the claws and legs are striped with blue and scarlet, giving it a most brilliant appearance. In an aquarium, crabs generally hide under some rock, and come out when anything eatable comes in their way. They have a voracious appetite, and have no hesitation about devouring any smaller crabs, of whatever species they may be.

The Edible Crab (*Cancer pagurus*) is almost too large a species for the aquarium, but small specimens may be kept until they outgrow the space allotted them. It is too familiar a species to need description. In the aquarium it is not so lively as the Green Shore-crab, and therefore not so interesting.

The members of the group known as Spider Crabs may all be recognised by the curious shape of the head, which narrows at its termination, giving it the appearance of a snout. One of the commonest of this family is the Harper Crab, or, as it is sometimes called, the Sea-toad (*Hyas araneus*). These crabs, from their comparatively sluggish habits, often have their shells completely covered with seaweeds and zoophytes growing parasitically upon them. One species, called the Thornback Crab (*Maia Squinado*), is almost invariably so covered with growing zoophytes that the shell is completely hidden.

The Slender-legged Crab (*Stenorhynchus phalangium*) is another member of the same group, and is comparatively often found on coasts where there is plenty of sand and mud left by the receding tide. The shell of this species is covered with small excrescences, and its body is elongated into a snout, the eyes being placed at the end of footstalks projecting from the head, something after the fashion of the antennæ of a

snail. This is, of course, to a certain extent the case with all crabs, but in *Stenorhynchus phalangium* the footstalks are much longer than in the majority of cases. The legs are very long in comparison to its breadth; hence its popular name.

We now come to the remarkable species of crab known as the Hermit or Soldier Crab (*Pagurus Bernhardus*, Fig. 80), the former name being given to it from its solitary propensities, and the latter on account of its fondness for a battle. The

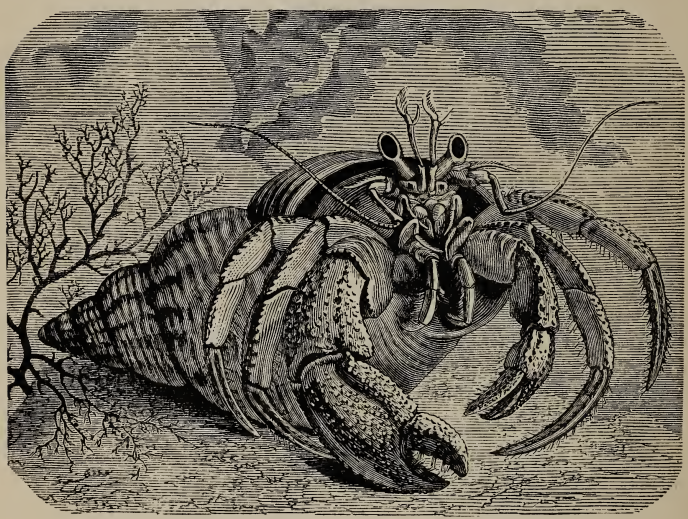

FIG. 80. HERMIT OR SOLDIER CRAB (PAGURUS BERNHARDUS), IN SHELL OF A WHELK (BUCCINUM UNDATUM).

extraordinary feature of this crab is that the latter half of its body, instead of being protected by the usual carapace, is soft, and easily injured, so that the animal has to seek some plan for himself to protect the soft portion of his body. His method is extremely efficient, for he takes up his abode in an empty whelk-shell, and travels about with it as if he had been born thus. He is provided with a special appliance,

resembling a pair of pincers, at the end of his body, for the purpose of firmly grasping the shell. With this he takes so firm a hold of the end that it is easier to pull the crab in half than to induce him to leave go of the inside of the shell. This formation is analogous to that of the caddis-worm in a fresh-water aquarium. On the outside of the shell when found will very likely be sitting a specimen of the Parasitic Anemone (*Adamsia Rondeletii—Sagartia parasitica*, Gosse, Fig. 39), as mentioned in the chapter on Sea-Anemones; while if his relative the Purple Soldier Crab (*Pagurus Prideauxii*) is found, there will almost invariably be a specimen of the Cloak Anemone (*Adamsia palliata*) outside the shell.

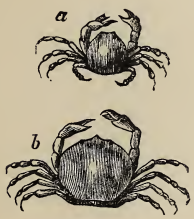

FIG. 81. PEA CRAB (PIMOTHERES PISUM). *a*, Male; *b*, Female.

FIG. 82. HAIRY BROADCLAW (PORCELLANA PLATYCHELES).

The Soldier Crab has two claws, as usual, but in his case one is considerably smaller than the other. The large claw is used for defence, and also for holding anything captured, while with the little claw the crab pulls its victim to pieces, and feeds itself.

The smallest of our British crabs is probably the little Pea Crab (*Pimotheres pisum*, Fig. 81), which is such an exceedingly minute crustacean that it is obliged to seek a haven of refuge from the buffetings of the waves and its numerous foes. This it does by secreting itself in the shell of a species of mussel, where specimens are almost always found. Although they live together, the mollusc and the crustacean get their food independently, though possibly what is left by the crab may be devoured by the mussel. The Pea Crab will thrive in an aquarium,

but must be guarded from the anemones, to which it will fall a victim if care is not taken.

The Hairy Broadclaw (*Porcellana platycheles*, Fig. 82) is one of a group known as the Porcelain Crabs, because the under surface of their bodies is shiny, and porcelain-like in appearance. These are wonderful little creatures, and deserve close attention in the aquarium. They are generally found on the under side of stones, at very low water, clinging so closely that a sharp eye is required to detect them. When put into an aquarium they vanish as if by magic, and will presently be discovered clinging to the under surface of some stone, as they were when first seen. The Hairy Broadclaw is a kind of link between the Crab and Lobster families, as in appearance it decidedly resembles a crab, yet has the last joint of the tail fringed with swimming-plates like a lobster, and the antennæ are much longer than the body. In general form and structure it closely resembles the Dutch Lobster (*Galathea squamifera*). It clings with such force to a stone that it is difficult to pull it off again. As it is a sedentary being, and usually remains in the same spot, it is provided with a remarkable apparatus whereby it can obtain food from the water without wandering about in search of it. If the two front claws are examined, they will be seen to be covered with a brush-like appendage; and if the crab can be induced to come close to the glass, on being watched it will be seen to continually make casts with its claws, each time bringing them to its mouth. The brush-like appendage is, in fact, given it to enable it to capture animalcules, &c., floating about in the surrounding water, without moving from its position in search of prey.

The common Lobster (*Astacus marinus*) is far too large a crustacean for the tank, but if small specimens can be found, they may be kept for a short time to observe their habits.

To the same family belong the shrimps and prawns, which if they can be kept alive, and do not fall victims to the anemones, whose natural food they are, will look most ornamental in the aquarium. Both creatures have the curious method of backward motion which distinguishes the Lobster and Shrimp families from the other crustacea. If a close

examination of the tail is made, it will be seen that the thin plates of which the fan at the end of it is formed are so arranged that, when drawn towards the head, they open, and offer a great deal of resistance to the water; but when drawn the other way, they collapse, and hardly impede the motion of the tail at all. When the shrimp wishes to advance, therefore, he does so by means of his feet, but on seeing danger ahead he simply bends his body suddenly, and the resistance of the tail drives him forcibly backwards out of harm's way.

The common Shrimp (*Crangon vulgaris*) can be obtained in any numbers by "tipping" a shrimper to let you choose specimens out of his net. In the aquarium they are considerably more elegant in appearance than they are on the tea-table, their translucent bodies and graceful movements adding much to the charm of their delicate colouring. In Fig. 79, the space above the crab is occupied by the common Shrimp, and in front of the crab is a figure of the common Five-finger Star-fish (*Uraster rubens*), which was mentioned when speaking of Star-fishes.

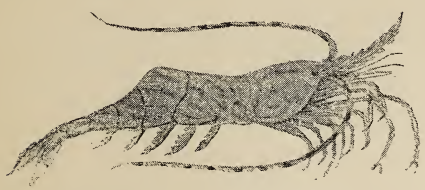

FIG. 83. ÆSOP PRAWN (PANDALUS ANNULICORNIS).

A more beautiful creature still is the Æsop Prawn (*Pandalus annulicornis*, Fig. 83), the body of which is transparent, and of a grey colour, tinged with a greenish hue, and with lines of scarlet at intervals. It has had the name of Æsop attached to it from the fabulist, who was hump-backed, as is this little crustacean, the hump being the natural formation of its body.

The eyes of both shrimps and prawns possess a remarkable faculty, analogous to that of many tribes of British insects, an especially notable example of which is the Death's-head Moth (*Acherontia Atropos*)—this is, that when the rays of a candle held by the observer fall upon the eyes, or when they are seen in weak daylight, they glow as if lighted up from

inside the head, and if seen in the dusk the effect of the two balls of fire is rather startling. The reason of this is not yet fully accounted for; it has been explained by the eyes being compound instead of single; but the glow departs with the life of the crustacean, as it does also with the life of the insect, and therefore must be due to something beyond the mere shape of the eyes.

One of the commonest species of crustacean, of which the observer cannot fail to encounter enormous quantities, is the Sand-hopper, or Sand-skipper (*Talitrus Locusta*), which has also a close relative in the Shore-jumper (*Orchestria littorea*, Fig. 84). These creatures are precisely alike in formation, with the exception of the front pair of legs, which take the form of claws in the Shore-jumper, but not in the Sand-skipper. Both species are sure to be found in abundance on any sandy coast. They burrow deeply into the sand, from which they emerge as the tide reaches them. They are also to be found in numbers in the pools of water left by the receding tide, and will probably be found in the fronds of seaweed collected for the tank. If introduced into the tank with the anemones, they will be speedily swallowed, so if any special interest is felt in them they must be kept in a separate vessel. In this case they must be provided with sand in which to burrow.

FIG. 84. SHORE-JUMPER (ORCHESTRIA LITTOREA).

The stones and rocks between tide-marks are almost invariably covered with myriads of minute white objects, which look like pieces of the solid rock, but are in reality very lively beings, belonging to the order *Cirrhopoda*. These are the Acorn-shells, or Barnacles (*Balanus balanoides*, Fig. 85), which are extremely interesting inhabitants of an aquarium. When I first tried to keep specimens of these creatures, I found that they would not live for more than a few days. At last it occurred to me that as they always adhere to rocks, &c., above low-water-mark, they are accustomed to be left high and dry for some hours every day while the tide is out. I therefore resolved to take

the stones to which they were affixed out of the water for a few hours daily, or at any rate every other day. From the time I took to doing this I had no further trouble with the Balani, specimens of which I have kept for several months in full health and vigour. These creatures, like the Hairy Broad-claw Crab, are provided with a wonderful instrument resembling a casting-net; with this they can catch minute animalcules in the water, on which they feed. It is an exceedingly pretty sight to watch a large colony of them when all are busily engaged in casting their nets, which they do with the utmost regularity. When one is watched, the two plates which form the upper covering are seen to open, and the net being thrust forth, a rapid cast is made from one end of the opening to the other. The net is then withdrawn, and the plates close again, the process being repeated again in a few seconds. This species is very short, and fixes itself rigidly to the rock.

FIG. 85. GROUP OF ACORN-SHELLS, OR BARNACLES (BALANUS BALANOIDES).

There is another Barnacle, known as the Ship or Necked Barnacle (Fig. 86), which is nearly always found on pieces of wood, spars, &c., torn from a wreck, after they have been floating about for some time in the sea. The shell of this Barnacle is set at the end of a very long stalk, the other end being affixed to the wood. The animal is known scientifically as *Pentalasmis anatifera;* the former appellation, signifying "five-plated," having been given to it from the fact that the shell is composed

FIG. 86. NECKED BARNACLE (PENTALASMIS ANATIFERA).

of five parts, joined together, from between the sides of which shell protrude the *cirrhi* (the scientific name for the casting-net); the latter (meaning "goose-bearer"), from an absurd idea formerly current that the interior of this Barnacle, in some extraordinary way, after it had grown to a certain size, acquired legs and a beak, and, dropping off into the sea, grew feathers, and became transformed into the fowl known as the Bernicle-goose (*Bernicla leucopsis*)! Those of my readers who have access to a book published in 1572, and named the "Cosmographia Universalis," by Sebastian Munster, will find therein an illustration of what he is pleased to call the Goose Tree (*Anseres arborei*); in this the geese are represented as dropping from the branches, which are laden with Barnacles in various stages of development! This is truly a noble effort of a lively imagination, but is eclipsed by Gerard, a writer in 1626, who states that he saw the process with his own eyes, and describes how it took place!

Having now described the method of setting-up and maintaining a marine aquarium, and given an account of some marine weeds and animals which are suited for enduring captivity therein, it only remains for me to express my sincere wishes for the success of the intending aquarium-keeper who will be guided by what I have written, and for the well-being and happiness of the animals of which he has the care. *Vale!*

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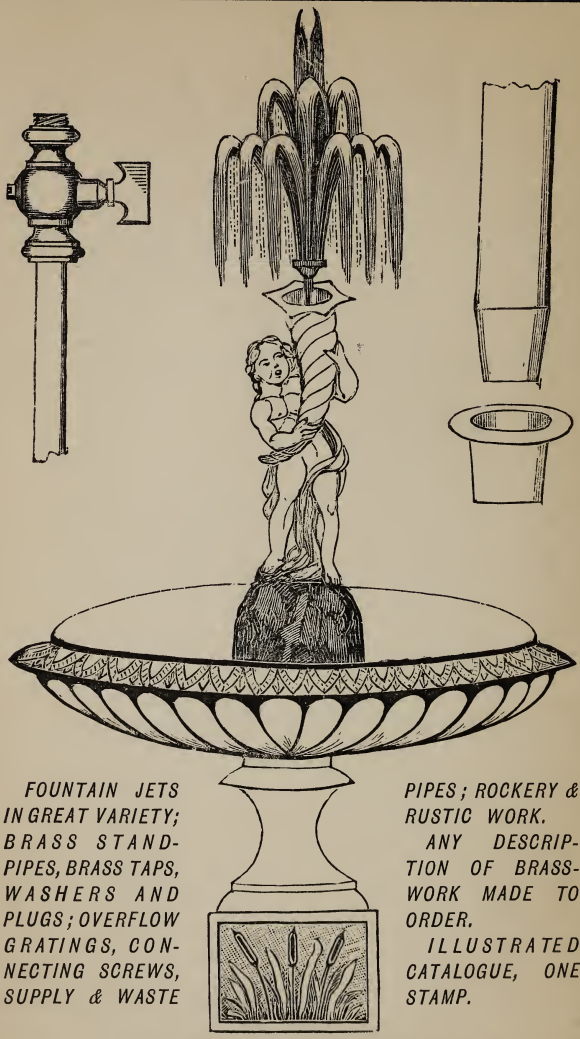

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Eczema Lotion
Eye Lotion
Hair Stimulant
Jaundice or "Yellows" Pills
Locurium Oil (Patent) for Anima Use
Locurium Oil (Patent) for Human Use (including Government Stamp)
Mange Lotion
Purging Pills
Rheumatic and Sprain Liniment
Rheumatic and Chest Founder Pills
Tonic Condition Pills
Vegetable Puppy Vermifuge
Worm Powders
Worm Pills

YOUR TRADESMAN OR STORES WILL SUPPLY YOU.

Spratt's Patent Limited, Bermondsey, London, S.E.

PAMPHLET ON CANINE DISEASES, POST FREE.